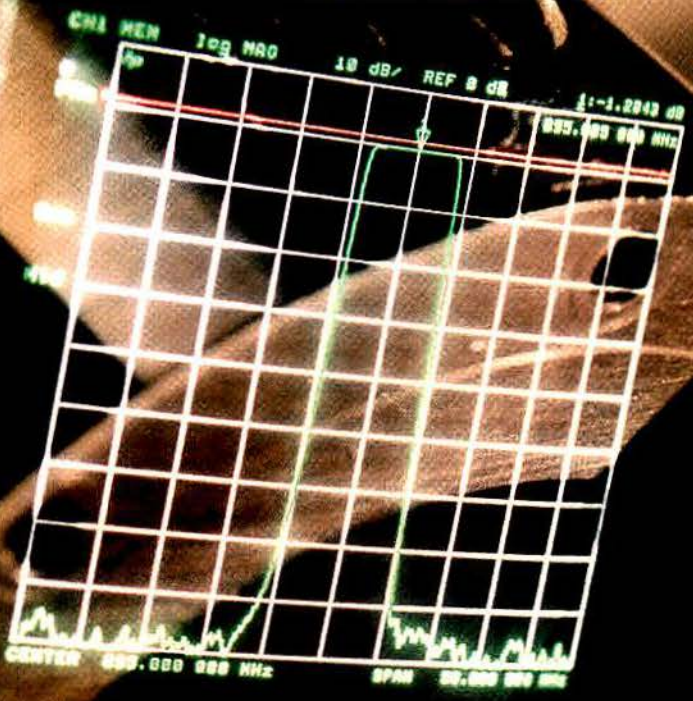
September 1995

Mobile Radio Technology™

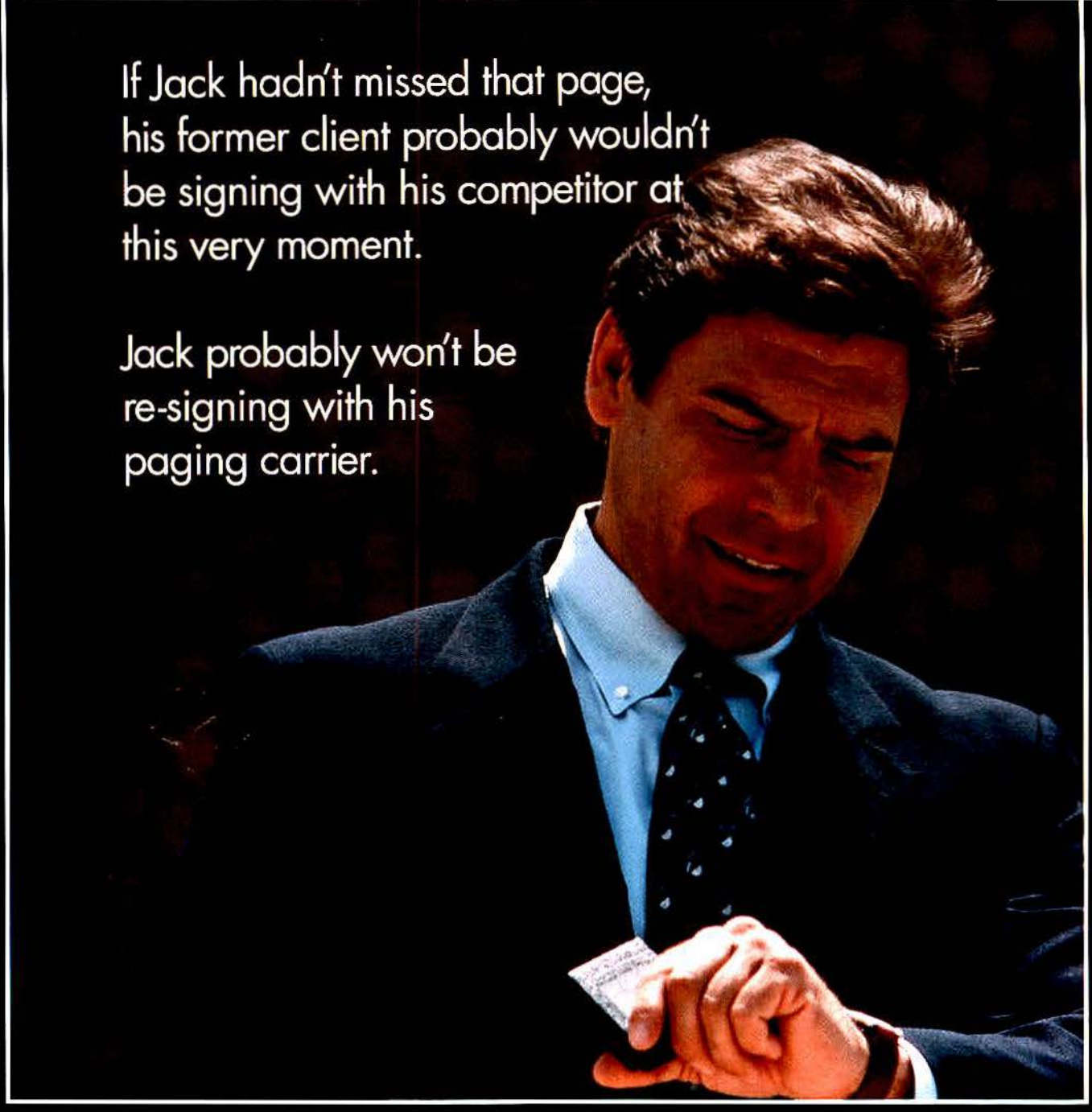
The journal of mobile communications technology



Superconducting filters, p. 10

- ESMR technology trends
- Acknowledgment paging
- PCS site acquisition
- Site security
- Subfleet trunking

An INTERTEC® Publication



If you want to maintain good customer relations and expand your coverage area, nothing must come between your paging signal and your clients, like Jack. That's why Allen Telecom Systems Division developed the PageThru® 900MHz repeater. It's the clear solution to overcoming obstructed signals in enclosed structures.

Now you can guarantee optimum paging service in less than perfect environments such as hospitals, office buildings, airports and tunnels. Not only does PageThru restore lost signal strength, it provides an affordable alternative to installing expensive paging base stations. PageThru helps you gain a competitive advantage, maximize revenues and increase your subscriber base. It's an investment that preserves your most valuable asset — your customers. Before your customers start to get impatient, boost your signal with PageThru. To learn more about the capabilities of this 900MHz repeater, call ATG at 1-800-664-5274. And keep Jack.

ALLEN TELECOM GROUP SYSTEMS DIVISION

30500 Bruce Industrial Parkway
Cleveland, Ohio 44139-3996
216-349-8400
FAX 216-349-8407

Your Wireless Connection.™

Visit us at PCS '95, Booth # 625.

Circle (1) on Fast Fact Card

The 10-site radio controller

Vega's C-5111 10-line/4-frequency console

Vega's Model C-5111 compact, easily rack-mounted, ten-line/four-frequency radio control console provides instant PTT, timed mute, and other most-needed features. This tone-format console allows you to quickly select one or any combination of up to 10 remote base stations. A second speaker allows you to monitor (with individual volume controls) any combination of those 10 stations that are not already selected for TX/RX control. Instant PTT switches allow immediate response to a call on a particular "selected" or "unselected" line, without disturbing the programming of the "selected" simulcast group or line.

Standard features available on the cost-effective and versatile C-5111 console include:

- **SELECTED switches** for selecting any combination of lines for transmitting and receiving
- **UNSELECTED switches** for monitoring any combination of unselected lines
- **TX ALL (simulcast) switch** for selecting all lines for both transmit and receive
- **RX ALL switch** for monitoring all unselected lines
- **Separate speakers and volume controls** for "selected" (TX/RX) and "unselected" (RX-only) audio
- **GROUP SELECT switch** for easy selection of TX/RX line combinations
- **TIMED MUTE switch** to mute "unselected" audio temporarily
- **Separate volume controls** for each "unselected" line
- **Instant-PTT switches** for each line
- **Line-activity LEDs** (function on all lines, selected or not)
- **Heavy-duty 120/240-V_{ac} power supply** (also runs on 12 V_{dc})

Options

- DCA-3 external three-line adapter for DC-format lines
- Gooseneck and desk microphones, headsets, footswitch
- DTMF pad
- Cross mute
- Clock, audio-level bargraph, and cross-mute indicators
- Rack-mount kit

The C-5111 has the flexibility to accommodate most any multiline console requirement. Call **1-800-877-1771** (toll-free) now for full details on the C-5111 console.

VEGA

a **MARK IV** company

Signaling Products Group

9900 East Baldwin Place
El Monte, California 91731-2294
Telephone: (818) 442-0782
Toll-Free Telephone: 800-877-1771
Fax: (818) 444-1342
FaxBack: (818) 444-2017
Toll-Free FaxBack: 800-274-2017

Circle (4) on Fast Fact Card

FLEX™. THE UNIVERSAL LANGUAGE OF

WHEN A
BRILLIANT
SOLUTION IS
CREATED ...

IT
WHIRLS
AROUND
AND
TAKES
FORM ...

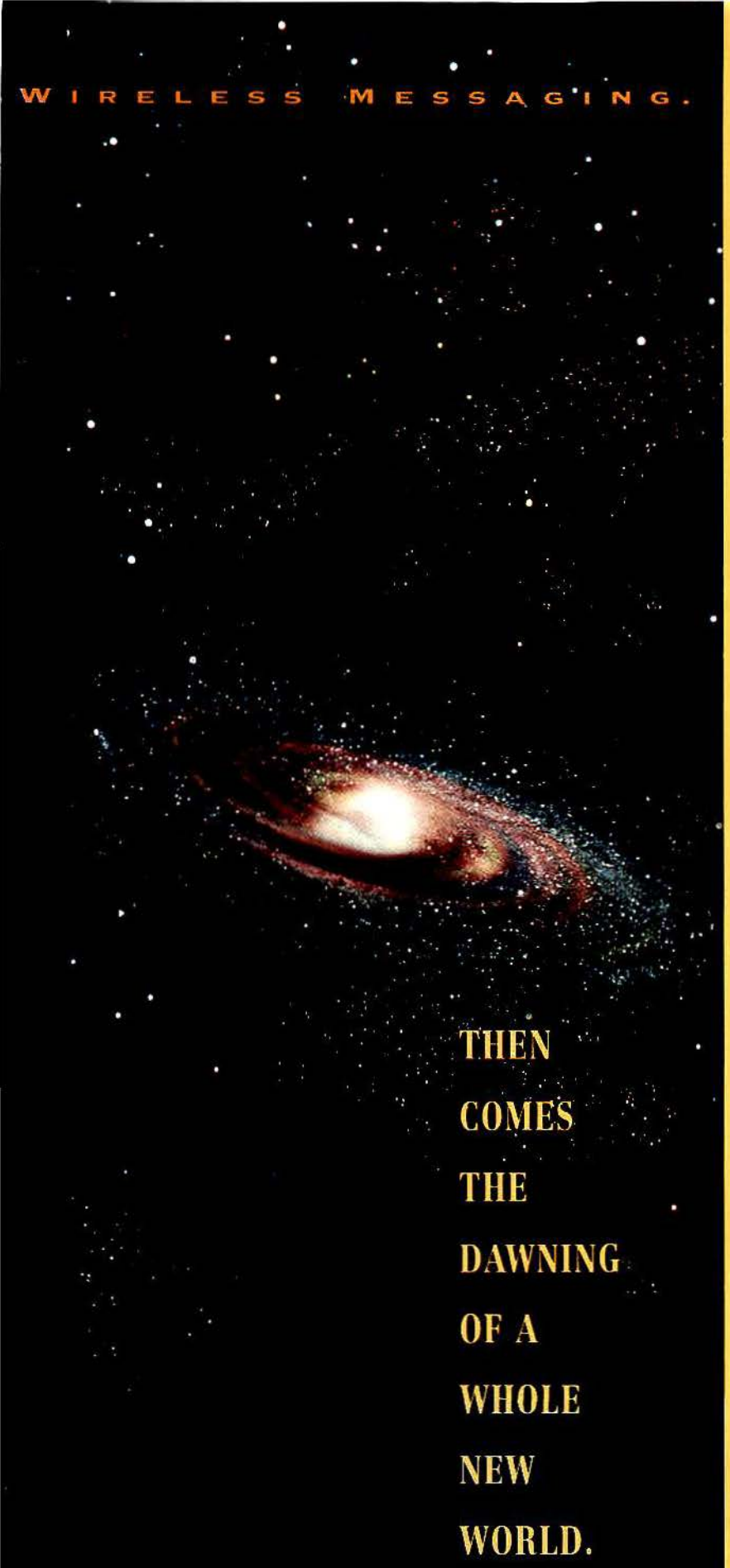
FLEX™. The emerging

standard in

wireless messaging.

MOTOROLA
Paging Products Group

WIRELESS MESSAGING.



THEN COMES THE DAWNING OF A WHOLE NEW WORLD.

FLEX™

The wireless messaging solution of the future is now fully formed and in place, offering a whole new world of business opportunity for wireless communication providers. Motorola developed the FLEX messaging protocol to move the paging industry into the 21st century. With FLEX, you can expand your current systems now... and move your businesses into the future of advanced wireless messaging. No other protocol comes close to offering the high capacity, graceful growth, improved page delivery, efficient mixing of services–even improved battery life. And, together with ReFLEX™ two-way messaging and InFLEXion™ voice messaging, the FLEX family of wireless technology solutions is the cornerstone of Motorola's strategy for the future of wireless communications. FLEX is rapidly becoming the de facto standard for messaging protocols, as indicated by its worldwide adoption and penetration. And because of this, FLEX promises carriers and end users innovation, a wide variety of FLEX products and global opportunities. The future belongs to the FLEXible–wherever there's wireless messaging on planet Earth.

FLEX

Circle (5) on Fast Fact Card

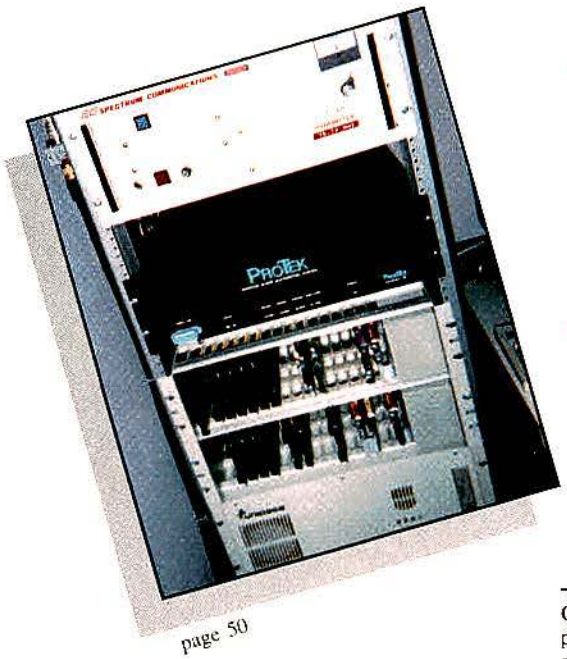
Contents

Mobile Radio Technology™

Volume 13, Issue 9

The journal of mobile communications technology

page 10



page 50

features

departments

On the cover: Superconducting, ultra-high-performance preselector filters offer systems engineers another tool to improve the performance of high-capacity, harsh RF environment cells. The superimposed spectrum analyzer display shows the frequency response of such a near-perfect filter. See Marc Rolfes' article on page 10.

Mobile Radio Technology (ISSN 0745-7626) is published monthly by Intertec Publishing Corporation, 9800 Metcalf, Overland Park, KS 66212-2215, and mailed free to qualified persons within the United States and Canada. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address change to Mobile Radio Technology, P.O. Box 12960, Overland Park, KS 66282-2960.
SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada: one-year: $30.00. Qualified and non-qualified persons in all other countries: one-year: $40.00 (surface mail); $105.00 (air mail). Subscription information: P.O. Box 12937, Overland Park, KS, 66282-2937.

STOP BROADCASTING THE SECRET TO YOUR SUCCESS!

Add .2 ounces of voice privacy to your 5.9 ounce MicroTac™

Cellular gave you convenience, Transcrypt gives you privacy.

Portable cellular phone security can now be invisibly embedded into your Motorola MicroTac™ and activated with a simple keypad button push. Transcrypt is the only company to accomplish this technological feat at an affordable price with superior voice quality.

Transcrypt has been providing complete voice privacy solutions for 16 years to over 10,000 public safety, government, and industry users around the world. Call us today to talk privately about adding protection to your vital cellular communications. We're ready to listen.

1-800-228-0226

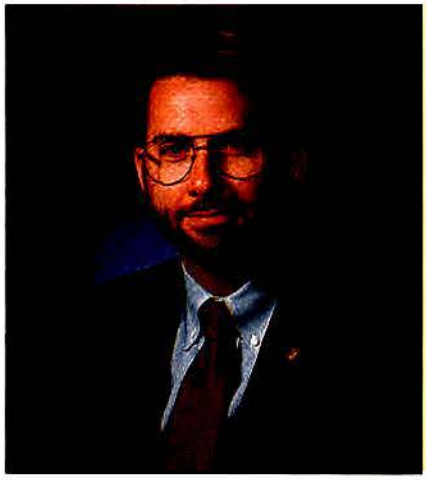
TRANSCRYPT™
INTERNATIONAL

4800 NW 1st Street, Lincoln, NE 68521 USA
402-474-4800 • FAX 402-474-4858
MicroTAC™ is a trademark of Motorola Inc.

Inquire about our Corporate Security Consulting Program

Circle (6) on Fast Fact Card

Advanced TV may allow broadcasters to compete in wireless telecommunications



This fall, the FCC is expected to choose the final standard for advanced TV (ATV) services. Among ATV services, high-definition television (HDTV) receives the most publicity. It includes a TV picture with an aspect ratio 16 units wide by nine units high, an aspect ratio similar to that of motion pictures. The current TV picture, with a 4×3 aspect ratio, cuts off motion pictures on each side to fill the TV screen from top to bottom. Along with motion picture compatibility, HDTV offers about twice the current resolution and, thus, greater picture clarity, because more scanning lines are used to compose the picture.

Over-the-air TV broadcasters, who use an enormous reserve of radio spectrum, are not necessarily keen on HDTV. The new technology is not expected to draw more advertising dollars, yet construction, including transmission facilities, cameras, switchers, editing and other equipment may cost billions of dollars.

Meanwhile, HDTV is beginning to be used overseas. Many American programs are sold for broadcast in foreign countries. To keep their leading position, American producers will have to offer programs in the new format. Cable TV channels can upgrade to HDTV less expensively than TV broadcasters, so broadcasters must consider the prospect of competition.

TV broadcasters face the operating expense of maintaining dual facilities for 10, 15 or 20 years as they continue to broadcast conventional TV signals while initiating HDTV broadcasts. It is no wonder that TV broadcasters might seek ways to earn additional revenue with spectrum assigned for HDTV. Proposals to deliver several program channels simultaneously or to deliver certain data services such as supplemental news, financial and sports statistics, find little objection from wireless telecommunications service providers. Conflict arises when proposals are made to allow TV broadcasters to deliver addressable communications, such as mobile data, paging and wireless network services using broadcasting spectrum.

Wireless telecommunications service providers (especially those that paid for spectrum assigned through auctions) might think it obvious that TV broadcasters (who are expected to be assigned HDTV spectrum without competitive bidding) should not be permitted to compete with them. It might not be so obvious to lawmakers who recognize the cost of constructing and operating HDTV facilities. Moreover, elections are affected greatly by what political programs and news TV broadcasters choose to carry. They are not affected much by what communications private wireless networks, paging systems and wireless telephone networks choose to carry. The political influence wielded by TV broadcasters can never be discounted when broadcasting and wireless telecommunications interests are in opposition.

* * *

Safety first

H. Dave Schmidtke, general manager of Dave's Electronic Service, Faribault, MN, wrote us with the sad news that the business's owner, Walter R. Bromenshenkel, died July 20 from an allergic reaction to a bee sting that happened while he was working at a remote telecommunications site. "Walter called in on the radio with a slurred voice and said he had been stung," the letter reads. "The shop dispatched an ambulance, but it was not in time.

"I hope you could find space in your magazine to remind all personnel to be aware of possible dangers at remote tower sites," Schmidtke's letter continues. "Also, all personnel should advise of their exact location, especially when alone at remote sites."

It always is safer to have two workers on a site when working on high-voltage equipment or a tower. Bromenshenkel's death reminds us all of the risk of working alone at remote locations, regardless of the task at hand.

* * *

Good news for PCS

Telecommunications legislation passed by the U.S. House of Representatives could lead to federal pre-emption of communications services (PCS) antennas, making it easier for system operators to obtain permits from local authorities. The same legislation would require the federal government to allow such antennas to be placed on its buildings.

Surprise—the U.S. Postal Service (USPS) already is leasing antenna space on its properties, and apparently such antenna placement is not subject to many local regulations. There's a bit of good news.

—Don Bishop

We're shipping the new Motorola R-2670 with secure test capability.

Big news! The new R-2670 Communications System Analyzer with SECURENET™ is now available for shipping! Bigger news yet: The R-2670 replaces our R-2000 series units and is the *only* test platform available that supports Motorola DES, DES-XL, DVP, DVP-XL and DVI-XL encryption algorithms!

Designed with encode and decode testing capability, the R-2670 also provides total testing parameters for Motorola SECURENET™ radios, including MTS2000™, SABER™, EXPO™, SYNTOR™, SPECTRA™ – *and* it can accept customer or test keys for encryption. In addition, the R-2670 can perform Bit Error Rate (BER) testing.

To arrange a demo or for additional information on the Motorola R-2670 with SECURENET™, call Communication Test Equipment today. Priced from $18,900 U.S. (list).

Order now.

800-505-TEST
FAX: 818-365-5742, Dept. 439

THE TEST you can TRUST™

MOTOROLA

Circle (7) on Fast Fact Card

Calendar

September

21-23—Personal Communications Showcase, sponsored by the Personal Communications Industry Association (PCIA). Orange County Convention Center, Orlando, FL. Contact: 800-326-8638.

October

16-18—International Conference on Power Requirements for Mobile Computing and Wireless Communications, sponsored by BIS Strategic Decisions, Santa Clara Westin & Convention Center, Santa Clara, CA. Contact: 617-982-9500.

18-20—International Wireless Communications Expo/Fall has been canceled.

19-20—AMTEX, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, Hilton, Walt Disney World, Orlando, FL. Contact: 202-331-7773.

26—ERA Communications Trade Fair, Ala Moana Hotel, Honolulu. Contact: 310-287-1218.

29-Nov. 1—Wireless Apps, sponsored by the Cellular Telecommunications Industry Association. The Mirage Hotel, Las Vegas. Contact: 202-785-0081.

November

7-9—WirelessWorld Conference and Exposition, sponsored by *Cellular Business* and *Mobile Radio Technology* magazines, Moscone Convention Center, San Francisco. Contact: Chris Lotesto, 800-458-0479.

9-12—Communications Marketing Conference, sponsored by the Communications Marketing Association, Albuquerque, NM. Contact: Bernie Brownson, 303-371-8182.

17—Radio Club of America, Communications Symposium, 86th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

1996

January

17-19—Mobile Communications Conference, sponsored by Frost & Sullivan, Westin Galleria Hotel, Dallas. Contact: Amy Arnell, 415-961-9000.

March

17-20—Energy Telecommunications and Electrical Association, Dallas Convention Center, Dallas. Contact: 214-235-0655.

25-27—Wireless '96, sponsored by the Cellular Telecommunications Industry Association, Dallas. Contact: 202-785-0081.

April

24-26—International Wireless Communications Expo, Las Vegas Convention Center, Las Vegas. Contact: 800-828-0420.

May

29-31—Radiocomm, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888.

June

24-27—Supercomm, sponsored by USTA and TIA, Dallas Convention Center, Dallas. Contact: 202-326-7300.

July

11-13—Communications Expo/Show of the Americas, Miami, FL. Contact: 305-229-9992.

September

19-21—Personal Communications Showcase, sponsored by the Personal Communications Industry Association (PCIA). San Francisco. Contact: 800-326-8638.

Mobile Radio Technology™
The journal of mobile communications technology

CORRESPONDENCE: Editorial and advertising correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66282-2901, 913-341-1300, fax: 913-967-1904.

MOBILE RADIO TECHNOLOGY provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional and cellular RCC and WCC, mobile radio equipment manufacturers, manufacturers' reps, distributors, engineering/consulting firms, national/state/local government, military agencies, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

BACK ISSUES: Copies of most issues printed within the past two years are available; older issues are not. Call customer service at 800-441-0294.

ARTICLE PHOTOCOPIES: Photocopies of individual articles printed since January 1983 may be ordered from UMI Information Store at 800-248-0360.

MICROFILM COPIES: Copies of issues by calendar year are available on microfilm for 1992, 1993 and 1994. Older issues are scheduled for microfilming later. Write UMI at P.O. Box 1346, Ann Arbor, MI 48106-1346, or call 313-761-4700 or 800-521-0600, Serials customer service, ext. 2895.

BPA ABP

Audited circulation. **$3.00 + 0.00**

INTERTEC PUBLISHING®

DCS CELWAVE
CELWAVE DISTRIBUTED COMMUNICATIONS SYSTEMS

Communication flaws can be serious at a major medical center.

That's why Loma Linda University Medical Center, in California's bustling San Bernardino County, called in the specialists: Area E Communications, local experts. And Celwave Distributed Communications Systems, national experts.

The diagnosis: urgent changes were needed. LLUMC's wireless system was faltering. Scattered equipment and excessive cabling were near the end of their service life. Inefficient energy distribution and cross-band conflicts reduced signal range and penetration. Paging transmitters failed frequently.

Compounding the problems: An ultra-hostile rf environment. A sprawling campus with dozens of buildings. A main building with many wings, walls reinforced with steel radiation shields, and below-ground floors. A heavily populated area. Mountainous terrain. And dozens of LLUMC user groups.

But the specialists, in a months-long operation, restored the aging system to vibrant, fully functioning health. Among a multitude of improvements, they replaced obsolete equipment...reconfigured cable routing to reduce footage by 40%...established additional base stations...and simplified the multi-band configuration supporting medical staffers, security, maintenance and other users.

They moved the main building's repeater up ward seven floors, and switched from cable to antenna...installed isolators on selected transmitters...integrated specialized coaxial relays into the paging system...and consolidated widely dispersed rf equipment at a single site.

Outside, they situated remote base stations for optimal performance...and replaced 20 aging metal antennas with fiberglass models.

Today, LLUMC communicates clearly over a 30-mile radius instead of five. Dr. Morton gets his messages on time, every time. And Celwave Distributed Communications Systems, specialists in diagnostic engineering, stands ready to cure your most serious ailment.

In the meantime, take two aspirins. And call us in the morning! 1-800-CELWAVE

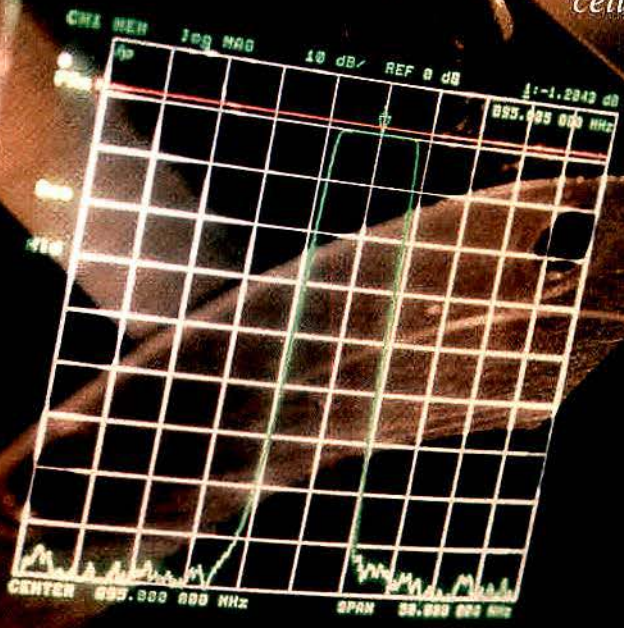
CELWAVE®
DIVISION OF RADIO FREQUENCY SYSTEMS INC.

2 Ryan Road, Marlboro, NJ 07746-1899 • (908) 462-1880 • Fax (908) 462-6919

Circle (8) on Fast Fact Card

Reducing the effect of RF Interference

Superconducting, ultra-high-performance preselector filters offer systems engineers another tool to improve the performance of high-capacity, harsh RF environment cells. Finally—the near-perfect filter.



By Marc Rolfes, P.E.

RF engineers have always dreamed of the perfect filter. How much easier life would be with filters that let through all the "good" and reject all the "bad." Even the FCC dreams of perfect filters to allow more efficient use of the RF spectrum (a commodity with increasing value if the $7.7 billion paid by future personal communications service (PCS) system operators for 99 licenses is any indication).

Although the search for the ultimate "brick wall" filter will last as long as the search for the Holy Grail, new ceramic materials allow close approximations. At first glance, the filter performance curve shown in Figure 1 to the right may not appear to be near-perfect because of the expanded horizontal scale. The spectrum analyzer plot in Figure 2 below right shows a more traditional horizontal scale that may cause you to look more closely. In fact, the filter represents an improved RF rejection capability 10,000 times better than conventional technology.

These new ceramic materials are known as *high-temperature superconductors*. They were discovered in 1987. "High-temperature" is relative. In this case, it refers to temperatures below −300°F, but that *is* higher temperature compared to the −450°F at which previous superconductors operated. Superconductors, when kept cold, allow RF energy to pass with such little loss that filters can be developed with significant performance improvements.

The fundamental performance measure of an RF filter is its quality factor, Q, which is defined by the ratio between the stored energy to the dissipated energy per cycle passing through the filter. In terms of frequency and using the impedance method, this ratio can be expressed as:

$$Q = \frac{f_o}{|f_1 - f_2|_{50\%}} = \frac{f_o}{\Delta f}$$

which is shown in Figure 3 on page 12. The Q of a perfect filter approaches infinity, whereas the Q of a traditional cell site filter ranges from 3,000 to 8,000. Especially high-Q filters with advanced dielectrics have resonators with Qs approaching 20,000. The unloaded Qs of first-generation superconductor resonators exceed 40,000 at cellular RF frequencies, with advanced designs promising Qs as high as 80,000 to 100,000. High Qs allow increased signal rejection without increased insertion losses.

First commercial application

For cellular base station applications, these filters are coming out of the lab at the right time. With U.S. cellular subscribers increasing by 50% in 1994 to 25 million, and with projections for 50 million subscribers by late 1996, the increasing interference and need for capacity have engineers working overtime to keep call quality high and dropped calls low.

Today, there are about 1,500 subscribers per cell. This number is projected to reach 3,700 by the end of 1997, even with a huge increase in base stations. This growth, coupled with the specialized mobile radio (SMR) users and air-to-ground telephone systems using adjacent spectrum is causing interference at 800MHz to increase. Today's well-operating cell may be tomorrow's nightmare.

For existing cellular applications, the weak link in the communications chain is widely recognized as the reverse channel path (mobile to base) because of reduced power emanating from a mobile, particularly the 0.6W (28dBm) hand-held portables. By the time the voice signal reaches the base antenna, the signal may have already diminished to −116dBm (maximum sensitivity), based on free-space path losses from a portable at the cell edge. This weak signal places a premium on the signal processing equipment's sensitivity, traditionally measured as a signal-to-noise ratio (S/N) capable of producing good call quality. Measures such as bit-error rate apply in digital applications.

The reverse channel provides an excellent first application of superconducting filter technology. Existing filter techniques to improve call quality, and other approaches such as sophisticated

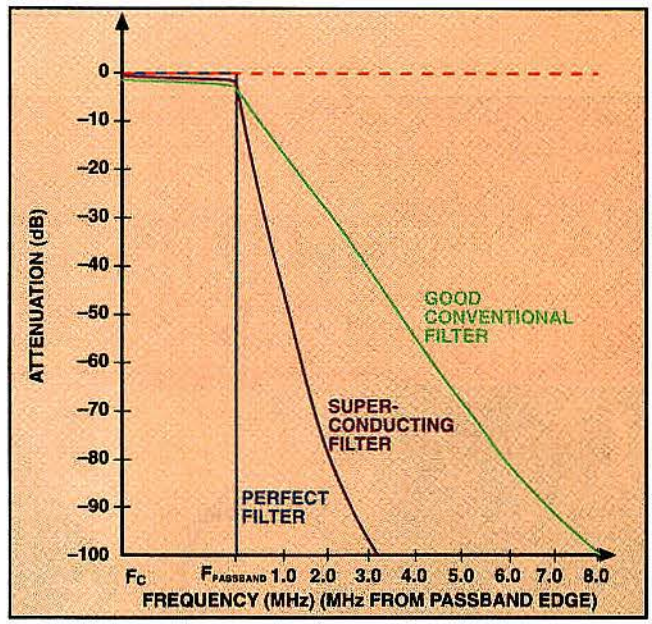


Figure 1. A perfect ('brick wall') filter does not yet exist, but new ceramic materials allow close approximations to be produced. The performance of the superconducting filter represents an improved RF rejection capability *10,000 times better* than conventional technology.

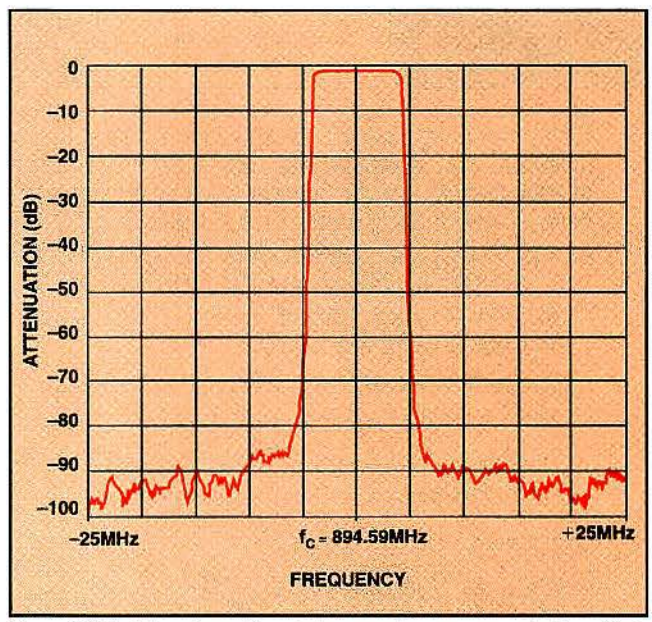


Figure 2. This filter attenuation plot represents a superconducting, thick-film, 16-pole Chebychev filter for a digital cellular application. The horizontal scale is 50MHz wide, 5MHz/division, centered on 894.59MHz. A picture of the actual CRT screen appears on page 10 (left.)

Rolfes is director of sales and marketing, Illinois Superconductor, Mt. Prospect, IL.

modulation techniques, are reaching their limits. The reverse channel provides a lower power application than on the transmit side. Lower power equates to less cooling and less demand on the superconductor material science. Although transmit filters represent an excellent application because of existing filter losses of about 5dB for a transmit combiner, they provide a more difficult challenge.

Superconducting filters are produced using two techniques: *thick-film* resonating cavity and *thin-film planar* filters. The resonating cavity designs place a thick film (about 50 microns) of superconductor material on the resonating elements used to produce traditional combline or interdigital filters, for example. Thin-film filters produce a filter structure on a one-micron-thick superconductor film in a manner similar to the way semiconductor manufacturers produce integrated circuit (IC) chips. Both techniques can appreciably improve adjacent band rejection with minimal insertion loss. To date, the measured interference rejection is better for thick-film designs. The trade-off comes in power-handling capability, size and the need for deep ultimate rejection—a decision left to the specific application.

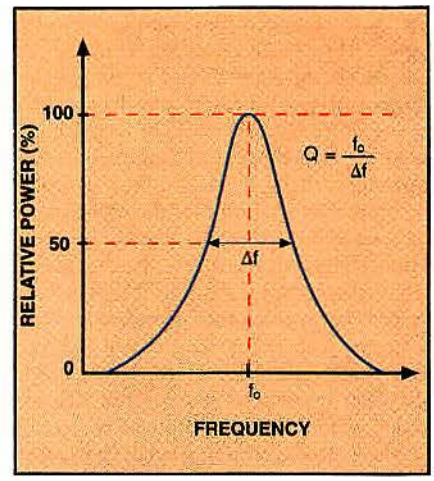


Figure 3. The Q of a perfect filter approaches infinity, whereas the Q of a traditional cell-site filter ranges from 3,000 to 8,000. Especially high-Q filters with advanced dielectrics approach a Q of 20,000. The unloaded Qs of first-generation superconductor resonators exceed 40,000 at cellular RF frequencies, with advanced designs promising Qs as high as 80,000 to 100,000. High Qs allow increased signal rejection without increased insertion losses.

Cellular receiver preselector filter

In high-capacity, harsh RF environment cells, a preselector filter often is used immediately after the base station receive antenna but prior to the receive multicoupler. (See Figure 4 on page 14.) With this placement, the receive multicoupler preamplifier performance improves because of the reduced incident RF energy. With cellular voice channels at high-capacity cell sites, the preamplifier is prone to non-linear distortion of the signals. With less incident RF energy, the preamplifier is better able to perform its function.

Although particularly good preselector filters may have an insertion loss of 2.0dB at the bandpass edge and adjacent band rejection of 15dB at 1MHz removed from the bandpass edge, a superconducting filter can reduce the insertion loss below 1.5dB while dramatically increasing the rejection value to greater than 35dB at 1MHz from the passband. Is selectivity a top priority? With a thick-film superconducting filter, more than 55dB of rejection has been measured at 1MHz removed from the bandpass with an maximum insertion loss of 1.3dB. This rejection capability

WHAT TO LOOK FOR IN A PATCH.....

CS-900 CONTROL STATION INTERCONNECT

A low cost interconnect that can be used straight simplex or through any conventional or trunked repeater system. *(Please see export note below).*

When comparing, please note that features such as Electronic Voice Delay, 90 memory speed dialer, built in keypad, and programming display are standard.

CS-800 FULL DUPLEX INTERCONNECT

A low cost interconnect for full or half duplex operation. Half duplex privacy mode is selectable. Has a built-in repeater maker. Speed dial capacity now increased to 90 numbers.

CS-700 INTELLIGENT SIMPLEX INTERCONNECT

A low cost simplex interconnect which gives the mobile positive control. Smart sampling places samples between words, so words are never lost. VOX Enhanced or VOX Controlled sampling are user selectable.

MODEL 9800 MULTI-MODE INTERCONNECT

An advanced interconnect for Base or Control Station applications. User selectable VOX Simplex, Enhanced Sampling Simplex or Half Duplex operation. Also has a built-in repeater maker. Will operate through conventional or trunked repeaters. *(Please see export note below).*

Options: 1/2 second Electronic Voice Delay, CTCSS operation, Dial click detection, Aux. relay, DTMF, CTCSS, 2 Tone or 5/6 Tone signalling.

MODEL 8200 FULL DUPLEX INTERCONNECT

An interconnect for full or half duplex operation. Half duplex privacy mode is selectable. Also has a built-in repeater maker.

Options: CTCSS operation, Dial click detection, Aux. relay, DTMF, CTCSS, 2 Tone or 5/6 Tone signalling.

MODEL 6800 RADIO/ TELEPHONE REMOTE UNIT

'AutoRemote' allows every phone on a KSU or PBX to double as a Radio Remote. Electronic Voice Delay is standard. Please note that the 6800 is not an interconnect and can be used in any city in the USA.

Option: DTMF, CTCSS, 2 Tone and 5/6 Tone signalling.

RT8 RURAL TELEPHONE SYSTEM

The RT8 system is used to put ordinary tone or pulse telephones into locations where wire service is not available.

EXPORT NOTE: Models CS-900 and 9800 have export versions that can dial through second dial tones with long wait delays, has Dial Click to DTMF signalling, and recognize non USA busy signals and dial tones.

Call *Ray Dashner* at **800-545-1349** today for the complete story!

In Canada: Cartel (800) 663-0070, Eastcom (800) 263-2323

Circle (10) on Fast Fact Card

TOLL FREE ORDERING AND TECH SUPPORT

(The price of Z competition's patch goes up when you order and with each tech help call because they do not support you with a toll free line).

BUILT-IN PROGRAMMING DISPLAY AND KEYPAD

Beware of patches that are programmed with DTMF. There is no way to verify entries or review previous entries. No patch can be set up as quickly and easily as a CSI patch.

EXCELLENT AUDIO

Only high linearity op amps are used. Better audio quality simply does not exist!

QUALITY / RELIABILITY

For thirteen years CSI has earned an impeccable track record for patches that work and keep on working!

FCC / DOC APPROVED

Beware: Some patches offered for sale are not approved for connection to the PSTN!

VALUE

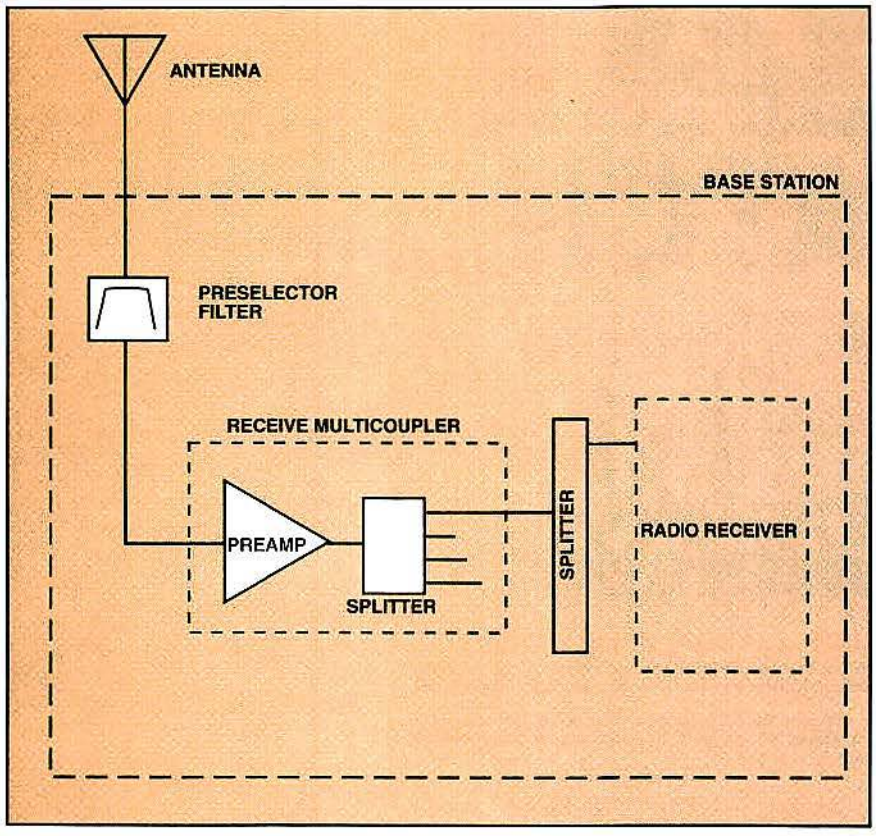
CSI brings you more patch per dollar than any competitor.

FEATURES

Many of our standard features are not available or optional in competing models. For example: 90 memory speed dialer, Redial, Five Click Autodial, CW ID and more. All features are user selectable and programmable.

CSI CONNECT SYSTEMS INC.

2259 Portola Rd.
Ventura, CA 93003
Phone (805) 642-7184
Fax (805) 642-7271



exceeds 10,000 times the rejection capability of conventional filter technology at 1MHz removed from the passband edge. Selectivity can be increased even further to as much as 65dB of adjacent band rejection with 2.0dB insertion loss.

In addition to reduced insertion loss and improved selectivity, deep ultimate rejection exceeding 100dB can be achieved using thick-film resonating cavity filter designs similar to conventional resonating cavity designs. The important difference is that the thick-film superconducting designs typically achieve ultimate rejection within 3.5MHz of the passband edge instead of the 7MHz–8MHz minimum typical of non-superconducting designs. Planar filter structures, though, do not exhibit deep ultimate rejection regardless of whether the design is based on thin-film superconductors.

Figure 4. In high-capacity cells in harsh RF environments, a preselector filter often is used between the base station receive antenna and the receive multicoupler. This placement improves the receive multicoupler preamplifier performance by reducing the incident RF energy. With cellular voice channels at high-capacity cell sites, the preamplifier is prone to non-linear distortion of the signals. With less incident RF energy, the preamplifier is better able to perform its function.

WHY GAMBLE WITH SPEECH SECURITY?

A ♥ TVS-2U

Tactical Rolling Code Voice Scrambler

- High-security scrambler with 100 million keyboard-programmable codes per system ID
- Thousands of unique system IDs available
- Greater than 84 x 10^9 year pseudo-random encryption sequence period
- Resynchronization for late entry or fading
- Digitally controlled audio processing
- Easily passes through repeaters and voters
- Best recovered audio quality in the industry
- Selective Call (Individual & 3 Groups)
- ANI, Status, and Location Reporting
- Stolen Radio Destruct & Triangulation/ Monitoring of lost or stolen radios
- Requires U.S. State Department License for export

A ♥

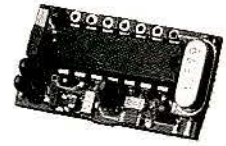
K ♥ TVS-2/Mic-Coder

Tactical Rolling Code Voice Scrambling Microphone

- Compatible with TVS-2 scramblers
- Durable microphone with backlit keypad
- LEDs: scramble mode light, call light, & transmit light

Passes Through Voters

Q ♥ VPU-8



Smallest Full-Duplex or Half-Duplex Speech Inversion Scrambler

- Single code inversion scrambler
- Motorola VPA compatible
- Simultaneously scrambles & descrambles
- Crystal controlled for high stability
- Very good recovered audio quality and speaker recognition
- Single input lead takes a ground to change between scramble and clear
- Available with flying leads

Q ♥

10 ♥ VPU-7

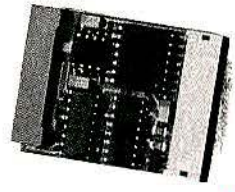
Smallest Simplex Inversion Scrambler

- Ultra-thin simplex inversion scrambler
- Single code scrambler
- Anti-aliasing input filter
- Crystal controlled for high stability
- Excellent recovered Audio Quality
- Microminiature quick disconnect connector with color coded leads for simplified installation and removal. Available with optional flying leads.

10 ♥

Best Recovered Audio

J ♥ VPU-2



Subminiature Tunable Voice Inversion Scrambler

- Easily tuned with high-stability 15-turn trim pot
- Anti-aliasing input filter
- Six-pole tracking output filter
- Simplex operation
- Excellent recovered audio quality
- Microminiature quick disconnect connector with color coded leads for simplified installation and removal. Available with optional flying leads.

J ♥

Passes Through Repeaters

With a Hand Like This, You Can Bet on Midian

To Order Call Toll Free: 1-800-MIDIAN'S

Telephone: (602) 884-7981

FAX: (602) 884-0422

MIDIAN

World Leader in Innovative Communications Technology

MIDIAN ELECTRONICS, INC. / 2302 East 22nd Street / Tucson, Arizona 85713

Although not all applications require deep ultimate rejection, some digital protocols such as code-division multiple-access (CDMA) are likely to exhibit performance improvements with the use of deep ultimate rejection near the passband edge.

For cellular and PCS systems, filter size is increasingly important. Not only should the ideal filter have perfect RF performance, it also should be extremely small. Compared to standard resonating cavity design filters, thin-film superconducting filters provide dramatic size reduction. These filters can be produced on a 3-inch-diameter wafer so that the six filters needed for a diversity receive, three-sector cell site can be packaged into a standard 19" rack-mounted device only 9 inches high. This package includes refrigeration. Thick-film filters, on the other hand, although smaller than conventional filters and getting smaller, will not achieve the smaller size inherent in the planar thin-film filters.

Power-handling requirements for wireless communications product applications vary dramatically. As mentioned earlier, the receive path from mobile to base represents a good first application because the power-handling requirements are dramatically reduced compared to the transmit path. Even so, the maximum continuous incident power-handling requirements for preselector filters in high-capacity, harsh RF environment cells can be as much as −10dBm. With today's superconducting material science, this requirement tends to favor a thick-film approach based on intermodulation (IM) distortion performance. The IM performance is inherently better for good-quality, thick-film superconductors at these higher receiver power levels. Measured values are better than −75dBc using a two-tone test at −10dBm.

Advantages of improved filters

Although improved filters are good to use, what advantages do superconducting filters provide? Three particular advantages affect both the cellular subscriber and carrier:

- Improved reverse channel (mobile-to-base) call quality.
- increased cell call capacity.
- improved flexibility of cellular site location.

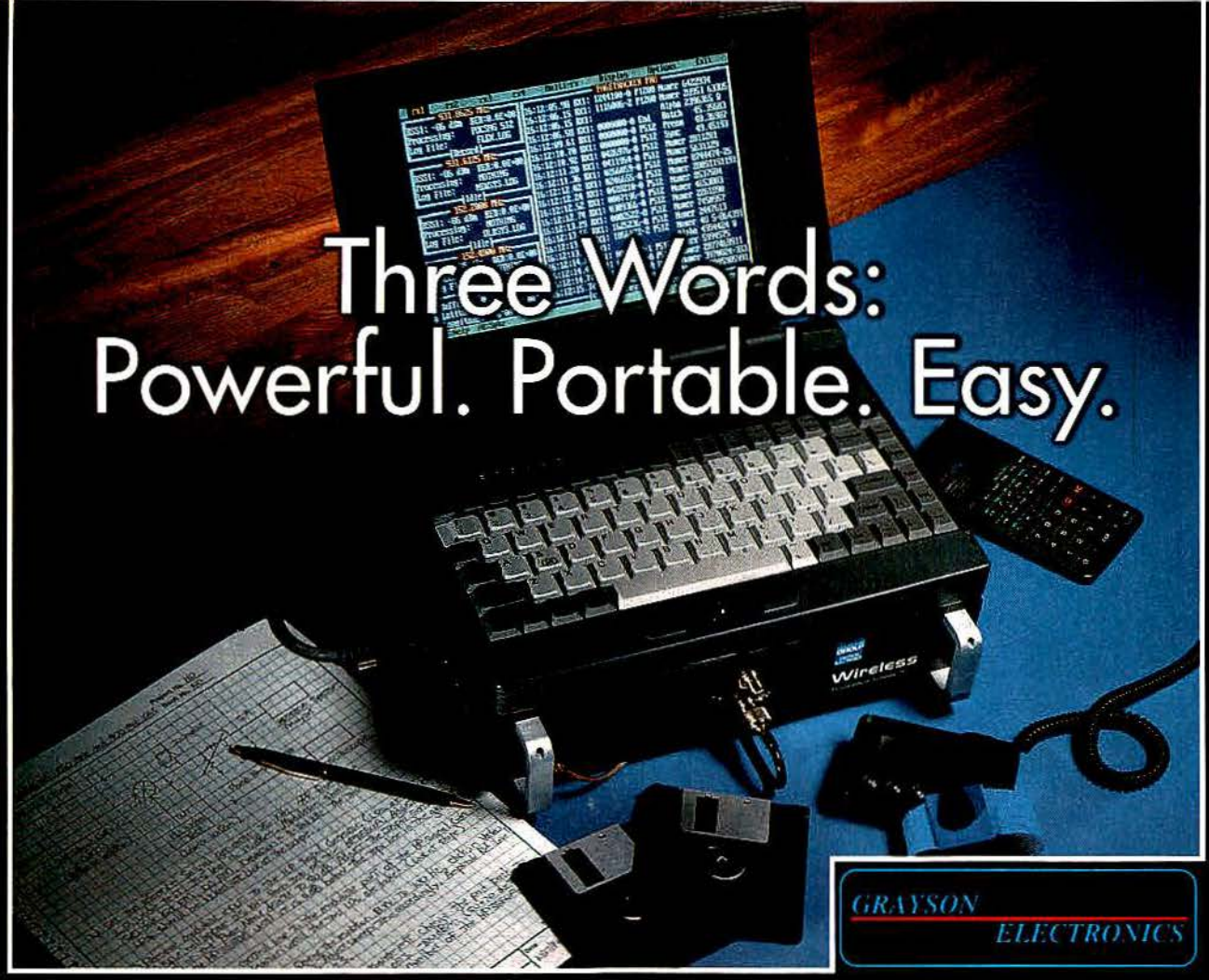
The improved reverse channel call quality is based on improved receiver sensitivity along with the resultant increased carrier-to-interference ratio in high-capacity, harsh RF environment conditions. Not only will the subscriber hear less noise, but fewer dropped calls should also result.

The increased cell call capacity is based on reduced occurrences of blocked (sealed) channels. A filter with extremely sharp roll-off also allows channels near the bandpass edge to provide good call quality during high-capacity operations.

Improved flexibility of site location is based on greatly improved signal rejection, allowing less-than-optimum geographic sites to be considered, including the potential for co-location in certain cases. This increased flexibility helps the carrier with reduced site procurement costs, reduced implementation time and reduced engineering costs.

Other applications

Besides cellular applications, many forms of wireless communications will benefit from improved filter technology. Areas already being worked on include microwave, PCS and satellite. In general,



One Tool: PAGETRACKER Pro™, The Paging Industry's New Standard in Wireless Measurement Instruments.

You want one instrument for all your network test and analysis needs. Your customers want quality paging service. Revolutionary PAGETRACKER Pro is the answer.

Advanced PAGETRACKER Pro packs a range of features and measurement capabilities never before available in a single, easy-to-use piece of test equipment. It reads all paging activity — including FLEX — in real time so you can see what's actually going out over the air instantly. Four easily tunable, independent receivers let you take up to four different measurements on a single channel, or the same measurement on up to four different channels. High-performance, ultra-stable receivers provide reliable, accurate measurements.

At under 10 pounds, PAGETRACKER Pro is a powerful, portable WMI that decodes all POCSAG, NEC, GOLAY, and FLEX paging signals virtually anywhere in your coverage area.

You can simultaneously measure signal strength, BER, traffic, interference and more, with comprehensive measurement capabilities like throughput, traffic statistics and batch efficiency. A NAVTRACKER GPS receiver provides multiple test results with position stamps to dramatically improve your troubleshooting. PROMAP® software automatically plots those results as a color map for a virtual blueprint of your system's strengths and weaknesses.

One tool. One company. One call. Contact Grayson Electronics today at 1-800-800-7465 to find out how PAGETRACKER Pro can help solve potential system problems before they become problems for your customers.

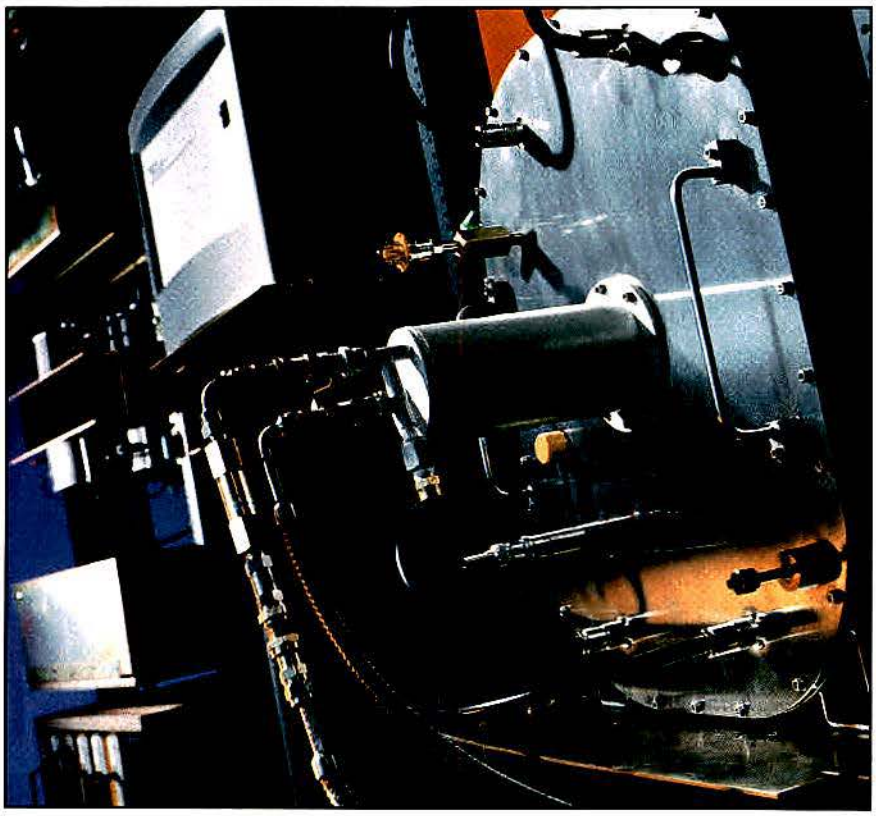
ALLEN TELECOM GROUP
GRAYSON ELECTRONICS
DIVISION

306 Enterprise Drive
Forest, VA 24551
FAX 804-385-7692

PAGETRACKER Pro is a trademark and PROMAP is a registered trademark of Allen Telecom Group Inc.

Your Wireless Connection.

Circle (14) on Fast Fact Card



The cell-site rack in the foreground shows a container holding three prototype superconductor, ultra-high-performance filters of the type represented in Figure 2. First-generation production units will be smaller, requiring about half as much rack space.

frequency ranges from 500MHz to 5GHz are good candidates for superconducting applications. This assessment is based on the reduced energy loss offered by existing superconducting materials when coupled with the refrigeration requirements as compared to the performance of existing technologies.

The superconducting, ultra-high performance preselector filter offers yet another tool for systems engineers to use to improve the performance of high-capacity, harsh RF environment cells. Other filter applications already have been demonstrated for both microwave and satellite communications. Should the prophecy of room temperature superconductor materials come true, superconducting RF filters will become commonplace, and filter engineers will be that much closer to producing the perfect filter.

Express yourself

Something bothering you? Want to sound off about it?

Need help that other readers might provide?

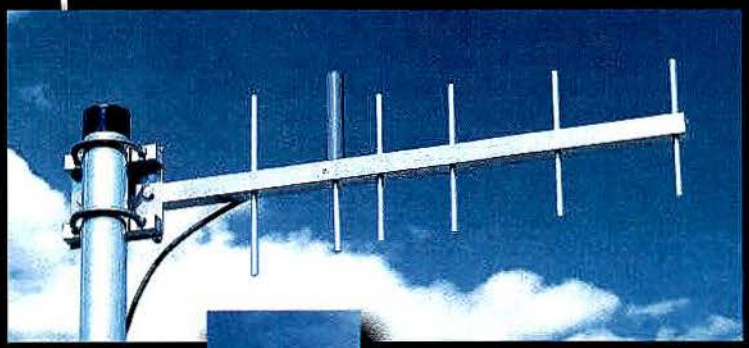
Send a letter to:

Letters to the editor
Mobile Radio Technology
P.O. Box 12901
Overland Park, KS 66282-2901

Performance Antennas

For Voice and Data Communications

Cushcraft/Signals has been building antennas for over 40 years. We offer a full line of base and mobile antennas that span a frequency range of 25 MHz to 2.5 GHz and a price range just as versatile. We are continually improving and expanding our product line to meet the demands of this dynamic market. Whatever your needs, chances are we can help.



Welded Yagis

Performance, long-life and economy were the design goals for the PC Yagi series. All welded construction means quiet, trouble-free operation.

- All-welded joints
- Sealed feedpoint
- Pigtail feed
- 6, 9, 11 & 13 dBd models

Fiberglass and Polycarbonate Omnis

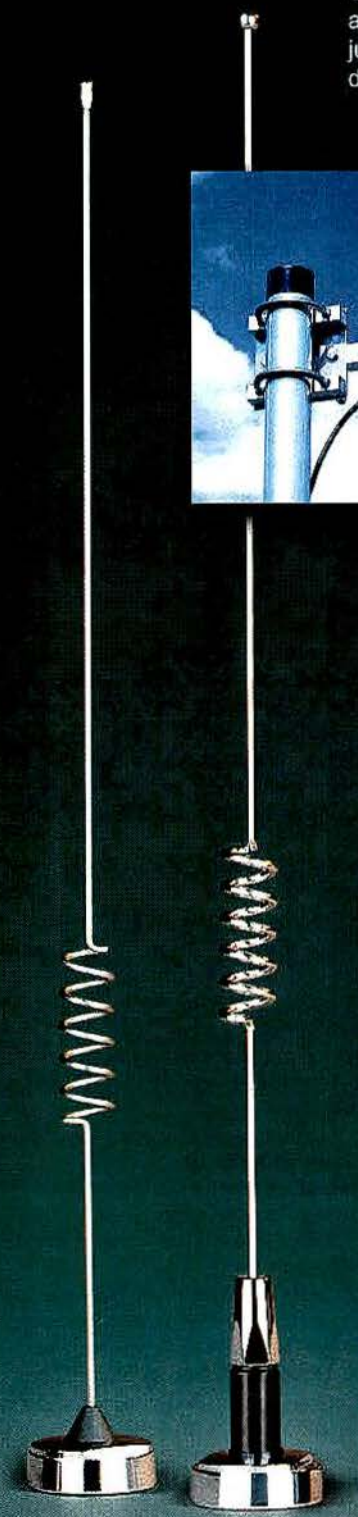
Available for 800 & 900 MHz, 1.4, 1.8 & 2.4 GHz

Omnidirectional antennas are available for all of the high frequency services from trunking and cellular through PCS and 2.4 GHz spread-spectrum applications.

- All-weather performance
- Choice of connectors • Cost effective pricing

Mobile Antennas

Cushcraft/Signals offers a complete line of mobile antennas for all applications from low band through PCS. Standard designs are available for delivery today from your favorite distributor.



ULTRALINK®
CABLE

Base and mobile UltraLink were designed specifically for communication applications. Low loss, ease of use, low cost and immediate availability are synonymous with UltraLink. See our catalog or call for details.

Cushcraft/Signals supplies a complete line of base and mobile antennas. Call us or your favorite distributor for fast delivery or our latest catalog.

1-800-258-3860
FAX:1-800-258-3868

cushcraft/Signals

Circle (16) on Fast Fact Card

48 Perimeter Road, Manchester, NH 03103 USA • Telephone: 603-627-7877 • FAX: 603-624-1764

PCS site acquisition made easy

Acquiring sites for personal communications services base stations requires a constellation of skills. Here are the steps that specialists take from project inception to delivery of a site ready for construction.

By Thomas Ehr and James Armstrong

Is the PCS* acronym in danger of being broadly known as standing for "predictable construction slowdown?"

Difficulties in acquiring and obtaining the required permits for base station sites may delay PCS system construction. PCS systems may need *five times* as many sites compared to cellular and enhanced specialized mobile radio (ESMR) systems to cover the same area.

There *is* some less-publicized *good news* about PCS sites.

□ In May 1995, the U.S. House of Representatives passed a measure that, were it to become law, would require the FCC to pre-empt certain state and local regulation of tower construction. Such a pre-emption would be expected to make it easier for PCS service providers to obtain tower construction permits.

□ PCS equipment generally requires less square footage compared to other wireless systems. In some cases, self-contained PCS equipment will not need an indoor, environmentally controlled equipment area.

□ PCS's shorter antennas will make it easier to place them on the numerous existing communications towers. Using existing facilities may or may not be more *economical* than new construction, but *development time* could be reduced by avoiding new construction. Nevertheless, many sites will require new construction.

*PCS is personal communications service, a wireless communications service that includes advanced paging and microcellular telephone services.

Ehr and Armstrong are real estate and construction managers at Turnkey Wireless Solutions, Oak Brook, IL. The company provides wireless communications implementation and management services.

Unfortunately, ESMR system construction and cellular expansion projects compete for the limited number of trained site acquisition specialists. One of the easiest solutions is to use seasoned, contracted site-acquisition personnel. Carriers not only can establish more sites in less time but also can eliminate the lengthy training period associated with new, inexperienced employees.

PCS site acquisition

Why is the site acquisition process so difficult and better left to outsourced experts?

The site specialist uses local real estate, construction and engineering information to evaluate the selected sites and to determine which is the best.

The first step is locating and evaluating potential cell-site locations that satisfy radio coverage and frequency reuse requirements—and client leasing budgets. Specialists use pertinent system design maps, cell-site grid data and other available documentation.

Site acquisition for PCS differs from cellular because site placement may be more critical. During early cellular system development, the "grid" often was given little attention.

Local real estate development, planning, zoning, flood plains, wetlands and national historic districts must be considered, too. Sites that require environmental impact studies are more expensive.

The site acquisition specialist identifies government agencies responsible for regulations, restrictions and permits. This step includes establishing contacts at the appropriate regulatory agency, securing necessary application forms and noting application filing and hearing schedules. Special-district, city, county, state and federal governments may be involved.

▶ *Required pre-search activities* — During the preliminary or pre-search phase of site acquisition, the site acquisition specialist

□ becomes familiar with RF engineering site specifications and the site data report form and identifies the technical characteristics that will satisfy data collection requirements during the search.

□ examines the search area using U.S. Geological Survey (USGS) topographic maps, local topographic maps (if available), planning, zoning, wetlands and flood-plain maps and regulations, assessor field cards and maps, and FAA sectional maps.

□ identifies usable site location areas within the search area using the background information developed above.

▶ *Initial field investigation* — During the initial investigation of proposed PCS search areas, the following data are developed:

□ the location of existing facilities on which to mount the PCS antennas, including:

- communications towers (e.g., cellular and ESMR).
- building rooftops.
- water storage tanks.
- grain elevators or other suitable structures.

□ the location of suitable land parcels in areas with favorable land use restrictions (e.g., industrial and commercial).

□ the location of land parcels in residential or other restricted zones that pose minimal functional and aesthetic impact on the surrounding area.

▶ *Site selection and negotiation* — The site specialist uses local real estate,

You Asked For It!

The Fastest, Most Powerful Spectrum Analyzer In Any Radio Test Set.

The New STABILOCK® 4032 Universal Analog/Digital Communication Test Set.

When our customers speak, we listen! You told us you needed a better spectrum analyzer in our STABILOCK basestation tester, so we added the fastest, most powerful spectrum analyzer available in any test set. Now, you have all the features you need to make the STABILOCK your test platform for the future:

- ☐ Ultra fast sweep-FFT analyzer
- ☐ 1dB resolution
- ☐ Graphic screens
- ☐ AUTORUN with zoom feature
- ☐ 2.3 gigahertz frequency option (PCS compatible)
- ☐ TDMA, CDMA, GSM, NAMPS, DECT, JDC

Call **1-800-392-8100** today for more information.
If you already own a STABILOCK 4031, ask about our upgrade!

Wavetek Corporation
128 Wheeler Road
Burlington, MA 01803
Phone- 800-392-8100
617-229-7585
Fax- 617-273-5943

Wavetek S.A.
Batiment Z.T.
B.P. 620-06
50 Av. Jean Jaures
F - 92142 Montrouge Cedex. France
Phone- 33 1 47 466700
Fax- 33 1 47 466727
Tele- 631 468

Wavetek Corporation
51 Goldhill Plaza, #14-04/05
SGP Singapore 1130
Phone- 65 356 2522
Fax- 65 356 2553

Wavetek GmbH
Gutenbergstrasse 2-4
D-85737 Ismaning, Germany
Phone- 49 89 99641 0
Fax- 49 89 99641 440

WAVETEK

Circle (17) on Fast Fact Card

construction and engineering information to evaluate the selected sites and to determine which is the best. Specific site-selection and lease or purchase activities include

- ☐ continuing pre-search and field investigations.
- ☐ selecting the site that appears to best satisfy the search specifications, contact with the site owner and a determination as to whether the owner might lease or sell the site.
- ☐ submitting the site's location and elevation to an RF engineer for approval (if the site owner agrees to negotiate).
- ☐ negotiating for lease or purchase using a standard lease or purchase agreement document as a guideline (after engineering approval).
- ☐ preparing a lease or purchase contract for signature.
- ☐ securing of signatures from all relevant parties to the lease or sale agreements.

Regulations

Once rights to the site are secured, it is time to fulfill regulatory requirements.

Using contacts already established at the appropriate regulatory agencies, the site specialist prepares and files the required applications. The specialist continues to assist regulatory agencies as necessary to secure the required approvals. Applications are typically filed with, and subsequent permits or approvals are typically granted by, a variety of concerned agencies.

▶ *Local planning departments* — If the proposed site is a new, build-from-scratch site, the local planning department may require an application and approval.

▶ *Local zoning boards or commissions* — Generally, zoning approval is required for all new site construction, and in some cases an application and approval are required for facility (building or tower) modifications.

▶ *Inland wetlands and flood plains* — Environmental considerations are generally associated only with new, build-from-scratch sites. They must be covered early on to avoid delays after rights to the site have been acquired.

▶ *FAA and FCC* — The site acquisition specialist makes sure that FAA airspace regulations and FCC licensing requirements are identified and fulfilled.

▶ *Other local, county or federal regulations* — It is necessary to verify that all other restrictions of any nature are identified and fulfilled, including hazardous materials and historical site requirements.

Upon completion of the regulatory phase, an application for a local building

POWER ON . . . with ASTRON.

Astron Corporation is the leading manufacturer of high-quality power supplies and converters for the land mobile industry.

With the new SL-11 series of low profile power supplies, specifically designed for base station applications, the setup is simple, easy and looks attractive. Just mount the radio, with the mounting pads (supplied with the power supply), to the top of the SL-11A (2¾"H x 7⅝"W x 9¾"D) or the SL-11R (2¾"H x 7"W x 9¾"D). The power supplies are very well regulated and will provide 11 amps of current at a 50% duty cycle. The units have fold-back current limiting to protect them from overload and short circuit, and an overvoltage protection feature to protect the radio should the output voltage exceed a safe level. All SL series units are available in dark gray or black.

Power supplies and converters from Astron: our unsurpassed quality and reliability have made us the #1 choice in the communications industry.

ASTRON CORPORATION
9 Autry, Irvine, CA 92718
Telephone: 714/458-7277
Facsimile: 714/458-0826

permit must be prepared and filed. If all goes well, construction begins shortly thereafter.

Why experience counts

Even strict adherence to guidelines cannot prevent problems; nevertheless, experience helps to minimize mistakes and to acquire high-quality sites within difficult time, money and regulatory constraints.

Along with the necessary technical skills in real estate, engineering and construction, the site acquisition specialist should have several other qualities.

▶ *Attention to detail* — While keeping an eye on the big picture, the site acquisition specialist has to stay organized despite handling volumes of pertinent data and has to have the flexibility to make modifications as needed.

Simply put, one cannot manage site acquisition without refined project management skills and adaptive cost-and-benefit decision-making. Mistakes or omissions can cause cost overruns and construction delays. For example, suppose a client's budget dictates using existing structures. If a more careful site analysis is needed but overlooked, the project may be stalled because floors at the site later may be found to lack structural integrity, or ceilings may be too low to accommodate base station equipment.

Towers can pose similar challenges. A tower analysis can indicate whether an existing tower can support the proposed PCS antennas, whether it can or should be modified for the new load and how to modify it cost-effectively.

▶ *Business acumen* — Only on-the-job practice gives the site acquisition specialist the ability to discern the best course in a range of business situations. Increasingly demanding landlords, mandated site co-location with other carriers and hostile regulatory agencies are just a few areas where good judgment comes into play.

▶ *Negotiation skills* — The ability to close leases or purchase agreements becomes especially important under deadline pressure. The specialist also must be able to discover "the path of least resistance" in securing the required approvals from all regulatory agencies (which frequently may not be sensitive to the needs of the communications community).

▶ *Communication skills* — More than ever, site acquisition can challenge one's poise and public-speaking and interpersonal skills. Because so many towers have been built for cellular, ESMR and other wireless systems, many communities have a heightened awareness. The site acquisition specialist may be required to assist in the presentation of data and to field questions from community or environmental opposition groups. In addition, after site construction begins, the site specialist may be called upon to inform the landlord of construction status and construction activities that may affect other tenants.

Conclusion

Each PCS site can present a unique set of leasing, permitting, radio design, construction and commercial challenges for PCS carriers. A carrier's reservations about its ability to quickly and efficiently develop its PCS network can be effectively satisfied by outsourcing the site acquisition function. Well-trained contract site acquisition specialists can substantially contribute to timely revenue generation, system growth and ultimate return on investment.

Introducing

SKYMARK®
VehicleTracker

Finally an Affordable GPS Based AVL System

Everyone, it seems, is talking about the Global Positioning System, or GPS. GPS is a recent innovation in precise low-cost satellite-based positioning technology. And, when installed in a two-way equipped vehicle, GPS-based Automatic Vehicle Location (AVL) systems are capable of streamlining fleet operations by showing dispatchers the accurate location of every vehicle in the fleet. Now Cimarron brings GPS/AVL technology to radio-based fleet vehicles, simply and without the "Big System" costs.

High Tech, Low Cost

We have made SKYMARK economical enough for virtually any dispatch operation to justify. We use ***exact electronic copies*** of the dispatcher's existing maps, on a simple, clear computer display. Plus our SKYMARK AVL system is a complete package (not just some pieces), and it can be installed and maintained by any radio service shop.

Your Fleet, Your Radios, Your Maps & Your Budget

SKYMARK VehicleTracker is geared to existing fleet management operations. Our low-cost vehicular GPS receiver interfaces to our micro-miniature data modem, that installs quickly *inside* the mobile radio. The modem's emergency "panic button" enhances personal safety and command outputs provide remote control in the vehicle.

At the dispatch center a compact radio channel controller receives vehicle location data from each unit with minimal impact on existing voice traffic. The data is then passed in real-time to a PC displaying an exact electronic copy of the paper maps the fleet uses every day. The location, unit ID, speed and direction, plus the "closest car" to an incident or assignment are shown clearly on the map display.

And There's More!

So call us and we'll show you how SKYMARK can provide a simple, economical and straight-forward AVL solution to fit your needs.

The mobile receives signals from GPS satellites.

SKYMARK's Mobile RF modem fits inside the mobile radio.

The vehicle ID, speed and direction are sent to the base display

PC running VehicleTracker® Software

CIMARRON TECHNOLOGIES

934 South Andreasen Drive, Suite G, Escondido, CA 92029
Call toll-free 1-800-487-7184 or 619-738-3282.

Use subfleets properly to boost trunking efficiency

Many trunked system users benefit from status and alarms, computer-aided dispatch, telephone interconnect, priority queuing and call-backs. Proper subfleet planning is required to take advantage of trunking efficiency.

By Matt Doyle

Not a day goes by when one does not hear of a new "wireless" communications device or technology that promises to make life easier and more productive. Unfortunately, although the amount of new products and services continues to grow, the amount of radio spectrum available to support such services remains constant. As a result, technology is often called upon to maximize the use of finite electromagnetic spectrum through bandwidth- or spectrum-efficient technologies or both.

Trunking is one such technology that promises increased efficiency by sharing a finite number of RF channels among a large, and often disparate, group of users. With trunking, an open channel is selected from a pool of available channels, and radios belonging to a particular user group are switched automatically to the open channel when a call is made by any user within the group.

Although a trunked radio system can be more efficient than a comparable conventional (non-trunked, single-channel) system, the efficiencies that are promised by a trunked radio system often are not realized. These shortcomings are not necessarily a result of an inherent flaw in trunked radio systems. More often, poor efficiency indicates inadequate planning and configuration of software. Just as a personal computer will not function optimally without properly configured hardware and software, a trunked radio system will not perform to its true potential if both of its component parts, hardware and software, are not optimized. After all, a trunked radio system is essentially an RF system under computer control.

So how can one be sure that a trunked system is properly configured and, as a result, maximizing its use of the available spectrum? A grasp of the fundamentals of a trunked radio operation and its effects on overall system performance helps.

What is a trunked system?

A trunking system is defined as a system in which a limited number of communications lines are shared by many users. In the case of a trunked radio system, the "lines" are RF channels, and users are groups of individuals usually belonging to organizations that require wide-area communications, such as public safety (police, fire and emergency medical services) agencies, utility companies and other fleet management organizations, such as taxi services and trucking companies.

. . . technology is often called upon to maximize the use of finite electromagnetic spectrum through bandwidth- or spectrum-efficient technologies or both.

From a hardware perspective, a trunked radio system consists of a fixed number of RF channels, normally ranging from a minimum of three to a maximum of 20, although some larger systems exist. Connected to the repeaters serving these channels, and providing oversight and control over them, is a centralized computer or distributed processor. In addition to these two fundamental components (repeaters and a computer), additional hardware or subsystems also can be incorporated into the system to enhance its basic capabilities. These capabilities or functions can range from a simple status and alarm system to computer-aided dispatch (CAD) to interconnections with external systems such as the public switched telephone network (PSTN). Regardless of the system's complexity, the fundamental of trunked operation remain the same.

Trunked operation

Operationally, a trunked radio system differs from a single-channel, conventional radio system in that any trunked system user can operate on any of the trunked system channels. In essence, users draw from a pool of channels instead of having to wait for communications to cease on a single channel, as would be the case in a conventional system. Users who otherwise might have to wait for a busy channel to open, as with a conventional channel, thus can use any open channel in the trunked system. In this way, trunking increases the use and efficiency of the radio system.

How the system determines which radio should operate on which channel at any given instant depends on the system configuration and the software.

Each radio on a trunked system is programmed with multiple identification numbers. The primary ID number, which is individual to the radio, is like a telephone number. The radio is also affiliated with a group of radios, sometimes referred to as a *subfleet* or *talkgroup*. The group ID number is like a telephone conference-call number. Subfleets and talkgroups are consolidated into still larger "groups of groups" commonly referred to as *fleets* and identified with a fleet ID number. The last and highest in the hierarchy of ID numbers is the *system* ID that defines

Doyle is senior systems engineer at I-Net, Bethesda, MD.

PERFORMANCE YOU CAN TRUST...

BATTERY AFTER BATTERY AFTER BATTE

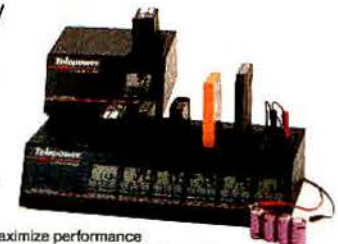
RY AFTER BATTERY AFTER BATTERY AFT

ER BATTERY AFTER BATTERY AFTER BA

JBRO...YOUR SMART CHOICE FOR QUALITY RECHARGEABLE BATTERIES.

Dependable communication is critical. Dependable batteries guarantee it. That's why more and more mobile communications operators everywhere are relying on the consistent quality and outstanding performance of JBRO rechargeable batteries.

Uncompromising workmanship and an extensive line ensure you'll get maximum power and a perfect fit for your specific application. Call today for our FREE catalog of highest quality battery products and services. Battery after battery, JBRO gives you performance you can trust!



Maximize performance and life of your rechargeables with JBRO's line of Telepower® Conditioner/Analyzers.

JBRO Batteries is a licensed participant in the Rechargeable Battery Recycling Corporation program for environmentally sound collection and recycling of Ni-Cd batteries

JBRO BATTERIES INC.

JBRO Batteries, Inc. 1938-A University Lane Lisle, IL 60532-2150 Phone: 708/964-9358 Fax: 708/964-9081 Order Entry: 800/323-3779 Fax Entry: 800/237-6435
JBRO Batteries S.W., Inc. 25700 I-45 North #111 Spring, TX 77386 Phone: 713/367-9393 Fax: 713/292-7139 Order Entry: 800/245-1138

Circle (23) on Fast Fact Card

all users permitted to operate on a given system.

In a normal trunked radio system, the communications are processed something like this: When someone needs to communicate with a member of the same subfleet, he keys his microphone. The radio signals the system to assign a radio channel. The electronic controller receives the channel request and checks to see whether any channel is idle and thus available for use. If a channel is available, the system signals the individual who initiated the call and causes all of the other subfleet radios to switch to the selected channel and commence operation—except in the case of a one-to-one or "private call," in which case only the one radio being called would switch to the selected channel and activate.

If no channel is available, the radio emits a *busy tone*, and the system places the user in a queue for the next available channel. Although systems can be configured in various ways, the normal configuration handles calls placed in queue in a first-in-first-out (FIFO) basis, such that those who have been waiting for a channel for the longest time receive a channel sooner than those who have been waiting for the least time. When a channel becomes available, the system signals to the user with a series of short beeps. Then the user has several seconds to seize the channel. If he does not do so, the channel returns to the pool to be made available for other users.

Although this process may seem lengthy and complicated, there are two key points to keep in mind. One is that the whole series of events occurs in less than 250ms,[1] and the other is that the operation is transparent to the user. As a result, the user is unaware of which channel has been assigned, yet he knows that a communication pathway has been established to exchange information.

What influences system efficiency?

Efficiency normally is defined as the number of users a system can support with a given number of RF channels, or more simply stated, the number of users per channel. Although this definition seems sound, there is a serious flaw as it applies to trunked radio systems. Because a trunked system is an *individual-to-groups* or *dispatch* type of radio communications system, as contrasted with the more common *individual-to-individual* system (such as the telephone network), the number of users does not accurately describe system efficiency. A more accurate indicator is the *number of user groups* the system supports.

Consider a trunked system with 250 users on five channels, all of which are available for voice traffic.[2] This system has *five subfleets* with the users equally divided among the subfleets. If five individuals, each one a member of a different subfleet, simultaneously request a channel, each of the five subfleets will be assigned

[1] Channel access times vary depending on the complexity of the system. Although single-site trunked systems normally have an access time of 250ms, multiple-site systems have access times anywhere from 500ms to in excess of one second.

[2] Although Ericsson and Motorola use one channel exclusively for signaling, other systems, such as those from E.F. Johnson, use voice and signaling on all channels. Although each type of architecture has advantages and disadvantages, for our example, we will assume all channels are available for voice traffic.

"YOUR BUYER'S GUIDE REPLACES THE 10 TO 20 CATALOGS WE USED TO USE. IT'S BY FAR THE BEST I'VE EVER SEEN!"

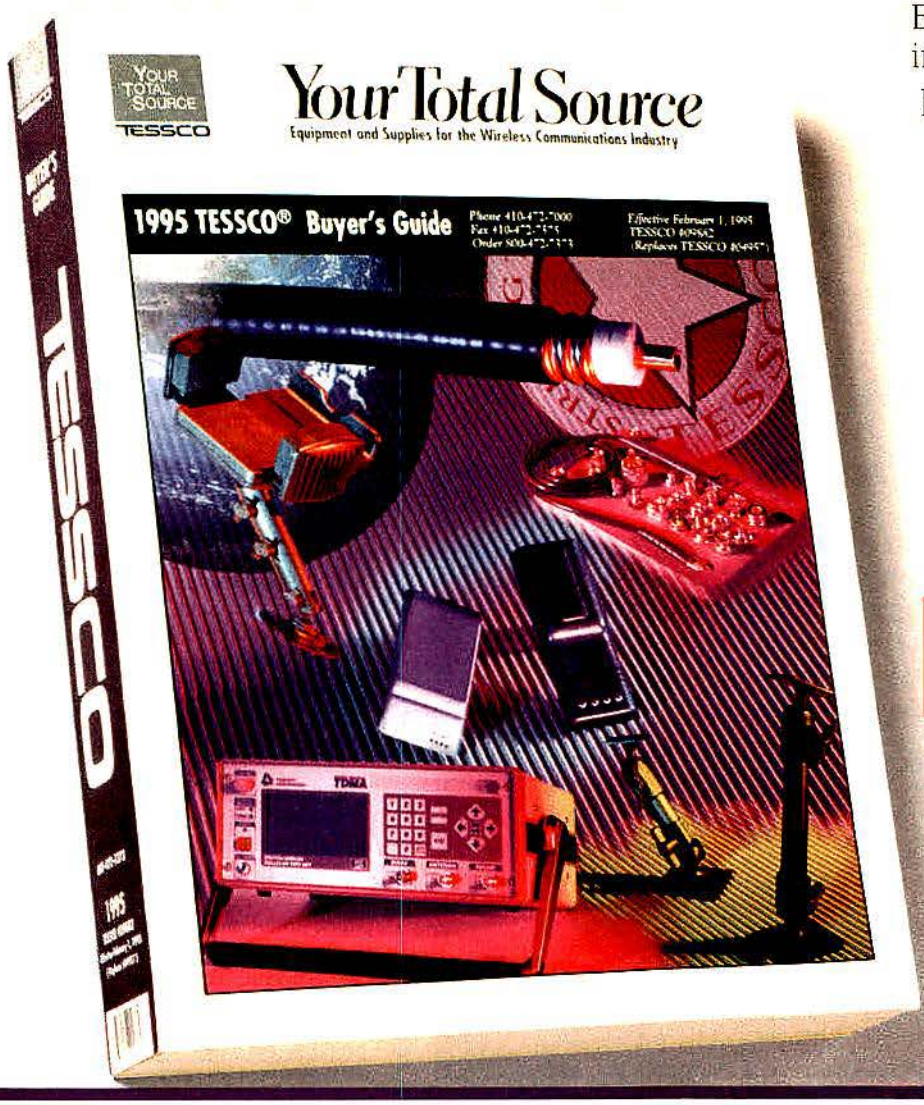
J. R. Rzucidlo
Radio/Metropolitan Communications, Inc.

12,000 Items.
Over 170 Manufacturers.
850 Pages.

Easy to use and fully indexed with complete product specs and guaranteed pricing.

Simplify your life. Call, fax or write to reserve your complimentary* copy of the wireless industry standard.

800.472.7373
410.472.7575 fax



NOT JUST A CATALOG

YOUR TOTAL SOURCE® TESSCO

TESSCO
34 Loveton Circle
Sparks, MD 21152-5100 USA
800.472.7373
410.472.7575 fax

*Complimentary to qualified service organizations

027

a channel. Because each of the five subfleets can use only one channel at a time, the maximum number of channels used at any one time is five. There never will be a busy period on this system, and users will have a communications channel available at any time.

Consider the same five-channel system, but this time with *125 subfleets* and the same number of users. The 125 subfleets would be the maximum allowable in the simplified system of 250 users (assuming each user had access to only one subfleet) because it takes at least two people to carry on a conversation. Once again, assume that one user from each subfleet places a call simultaneously. There are 125 requests for a channel, but only five channels available, so 120 users requesting a channel receive a busy signal

The number of user groups for an actual five-channel system normally falls between these two extremes, and the probability of one user from each group requesting a channel at the same time is unlikely. In fact, the basic premise of trunking is that not all users will attempt to use the system simultaneously. These examples demonstrate how the number of user groups, not the number of users, has a lot to do with the efficiency and, thus, the effectiveness of a trunked system.

Other influences

In addition to the size, quantity, and interconnectivity required among of distinct user groups within the system (commonly referred to as a *fleetmap*), there are other system characteristics that affect efficiency, such as a *telephone interconnect* (mobile phone call) and a *private call* (a conversation arranged between two users on the system so that they cannot be heard by other group members).

In fact, the basic premise of trunking is that not all users will attempt to use the system simultaneously.

In either case, the channel is occupied exclusively by the person who initiates the call, and the channel is taken out of the pool of channels available for other system users. Unlike a *subfleet call* that involves all the members of a group, a telephone interconnect or private call involves only one or two users. Either one uses an entire channel, the same as a group or subfleet call would.

Consider once again a five-channel system with 250 users. Five users simultaneously request either a private call or telephone interconnect. The system grants each user a channel, so all five channels become occupied by these users. Any of the remaining 245 users who place a call during this time hear a *busy tone*, and their calls are placed in the *busy queue*.

The solution

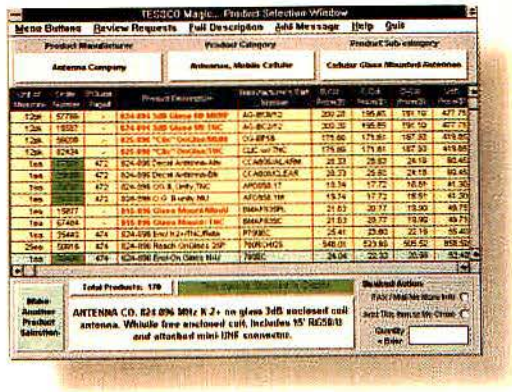
So now that we know some potential pitfalls of trunked systems, what is the optimal configuration? The minimum number of subfleets? The maximum? Telephone interconnect for all, or for none? Well, the answer is: *It depends.* The primary concern is the users' requirements. Once these requirements are known, it is

POINT. CLICK. ORDER. ANY QUESTIONS?

Installation is easy and takes less than five minutes.

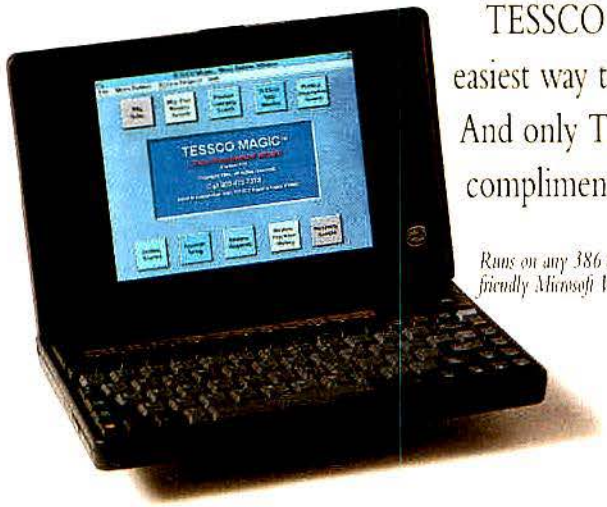
Introducing TESSCO Magic™, the revolutionary new buyer's guide and procurement software from TESSCO.

Just point and click for complete information on our entire selection of more than 12,000 wireless products from over 170 manufacturers.



Five search modes let you find information on any of our 12,000 products in seconds.

Compare pricing and specifications, build an order, calculate destination and handling charges, create a purchase history, even transmit your order instantly via fax/modem any time of the day or night. All without so much as opening a catalog or picking up the phone.



TESSCO Magic™. It's the newest, fastest, easiest way to find and purchase everything you need. And only TESSCO has it. Call, fax or write today for your complimentary* copy.

Runs on any 386 computer in user-friendly Microsoft Windows™.

YOUR TOTAL SOURCE
TESSCO

800.472.7373 / 410.472.7575 fax

Visit our new World Wide Web site http://www.tessco.com

TESSCO • 34 Loveton Circle
Sparks, Maryland USA 21152-5100

033

*Complimentary to qualified service organizations. ©1995 TESSCO Technologies Incorporated. Windows is a trademark of Microsoft Corp.

possible to define a system to meet them. This may seem obvious, yet many systems are designed and implemented based on *perceived* requirements and not *actual* requirements.

One unique ability of a trunked system is the ability to create as many subfleets or *virtual channels* as there are requirements for dedicated communications. For example, if within a police department there is a need for separate groups for dispatch, patrol, investigation, administration and training, separate subfleets can be created to handle each requirement. To prevent multiple subfleets from clogging the system, either procedures or radio programming must be implemented to restrict subfleet radio communications for their intended purpose only. Remember, creating a large number of subfleets does not automatically decrease the system efficiency because a subfleet only uses one of the RF channels when one of its members is talking (or sending other information) on it.

The problem that often occurs with an organization that is upgrading from a conventional system to a trunked system is that it simply replaces what was formerly a discreet RF channel with a subfleet. For example, if a police department formerly was operating on three channels, one for dispatch and two for operations, the trunked system would be set up for three *subgroups*: one *dispatch* and two *operations*. This system organization obviously is not of much benefit because the system operation will resemble the old conventional system. Once there is activity on the three subfleets, a user would have the same problem on the trunked system as he would have had on the conventional system: having to wait for the channel to clear. In fact, the department does not benefit from the *communications efficiency* offered by trunking at all, although it can take advantage of extra functions such as emergency alarms, priority queuing and call-backs.

As for functions such as private conversation and telephone interconnect, the users' requirements must be weighed against these functions' potential effect on system performance. Most, if not all, functions such as telephone interconnect and private conversation can be defined for specific radios. Individuals with the proper authority, responsibility or both could have radios with these functions, and other users could have radios with fewer functions.

What does the future hold?

With the imminent arrival of digital radios, will these same issues be important in future systems? *Definitely.* Although digital radio will increase channel efficiency and signaling capabilities, as system capabilities grow, the planning required to exploit these capabilities also will grow.

Beyond the complexity of trunked radio system technology itself, the most important components—and the one that most often impedes successful implementation of a trunked system—are the operational and management changes that must be made.

First, people do not like to change something they are familiar with. Second, supervisors sometimes uncomfortable with relinquishing some control over their subordinates. Nevertheless, as users and managers come to understand the benefits of trunking, they embrace it.

Eagle Telecom International...
...Defining The New Frontier For Power Amplifiers!

Most power amplifiers in today's telecommunications market rely on circuit board materials incapable of handling the typical thermal stress found in most paging, SMR and cellular applications. In addition, typical applications require the power transistors to operate beyond their rated specifications.

Eagle Telecom International's new leading edge line of SMR, cellular and paging power amplifiers are now setting the standards for the whole industry. Eagle power amplifiers are designed with space age technology that allows sustained high power output in extreme conditions while operating at lower temperatures. Eagle's design dissipates heat by utilizing new high dielectric thermally conductive circuit board material that was originally intended for earth orbiting satellites. New high power transistor technology gives Eagle power amplifers high power stamina, while operating well below the tested specifications.

Stop relying on yesterday's power amplifiers; thrust your system into the "New Frontier" by investing in Eagle Telecom's power amplifiers. They are truly "Out Of This World" in more ways than one!

Manufactured in Houston, TX, USA.

EAGLE

Eagle Telecom International

1-800-628-3910

(713) 280-0488
Fax: (713) 280-0381

Circle (29) on Fast Fact Card

ESMR technology trends

Advantages and difficulties come with the leading-edge technology used to give ESMR systems more spectrum efficiency and more functions compared to analog SMR. Compatibility with PCS is an issue, too.

By Clare G. Keeney

Enhanced specialized mobile radio (ESMR) is new and largely undefined. Its digital modulation replaces the analog frequency modulation (FM) used by current SMR radios—that much is commonly understood. Other functions include data transmission, roaming and call hand-off.

The forces of technology and market economics both act to form ESMR. More users per channel are required to offset capital construction cost, and new services are desirable (if not necessary) to allow ESMR to compete with cellular and personal communications services (PCS). ESMR relies on leading-edge technology to carry more users per channel and to offer new services, but technical problems with this same technology will delay customer acceptance.

Expanded channel capacity

In the United States, SMR systems use various frequencies, including 14MHz of radio spectrum between 800MHz and 900MHz. Each channel is 25kHz wide.

Keeney is vice president of engineering and a founder of Monterey Telecommunications Technology, Los Gatos, CA. The company manufactures equipment for SMR applications, including audio circuits designed for toll quality and (when necessary) echo cancellation.

Analog SMR systems at existing repeater (network transmission) sites that already occupy some of this spectrum are slated for conversion to ESMR. It would be advantageous for any new product to allow channels to be converted one by one as needed for the capacity expansion. Such a requirement would make it unwise to use a radio technology requiring a large band of contiguous frequencies—code-division multiple-access (CDMA), for example, which may require 1MHz of spectrum or more.

When the cellular industry faced the same decision a few years ago, it settled on a 3:1 gain in channel capacity, using time-division multiple-access (TDMA). A TDMA radio can use existing channels. Because it does not require large, contiguous frequency bands, it can be phased in, channel-by-channel.

The Motorola TDMA radio used in early ESMR sites achieves an expansion ratio of six channels for each existing 25kHz analog FM channel. Users in field trials have objected to the voice quality and to echoes, and the eventual acceptance of the technology is questionable.

Other proposed types of ESMR products will require different bandwidth allocations for transmission technologies such as CDMA.

Voice coding

The technology used to convert a voice from analog to digital is well-understood. Several systems are in widespread use, and hundreds more have been studied and are being studied in the laboratory. Telephone systems worldwide use the benchmark standard pulse-code modulation (PCM) digitized voice, created with a 64kbs (kilobits per second) bit rate, with unquestioned success.

The faster the bit rate, the more bandwidth is required to carry the voice. Because radio bandwidth is costly, equipment designers are under pressure to reduce the bit rate to fit narrower bandwidths. Digital radio circuitry creates electrical "symbols" that are modulated onto radio waves, transmitted over the air, and detected by the receiver. Each of these symbols can represent a bit of information.

Voice coding that produces recognizable words of synthetic quality (the so-called mechanical voice) can use bit rates as low as 0.5kbs. The IS-54 standard used for North American cellular telephony uses 8kbs and uses a technique called linear predictive code (LPC) for digitizing voice.

In simple terms, LPC determines the *future* shape of a voice waveform by analyzing its shape during the past few milliseconds. This future waveform can then be generated by the receiver without having to transmit any more than address information. Public acceptance of the IS-54 cellular quality is marginal, but probably widespread enough to capture a substantial share of the market. It is extremely attractive to cellular carriers because it fits existing cellular channels.

Sophisticated voice coding requires considerable computer processing to create the resulting digitized voice. As the bit rate is reduced, the required processing power increases, and the delay between talking and transmission increases. Voice quality degrades along with bit-rate reductions, even with well-designed LPC schemes. Table 1 to the left shows relationships among these variables.

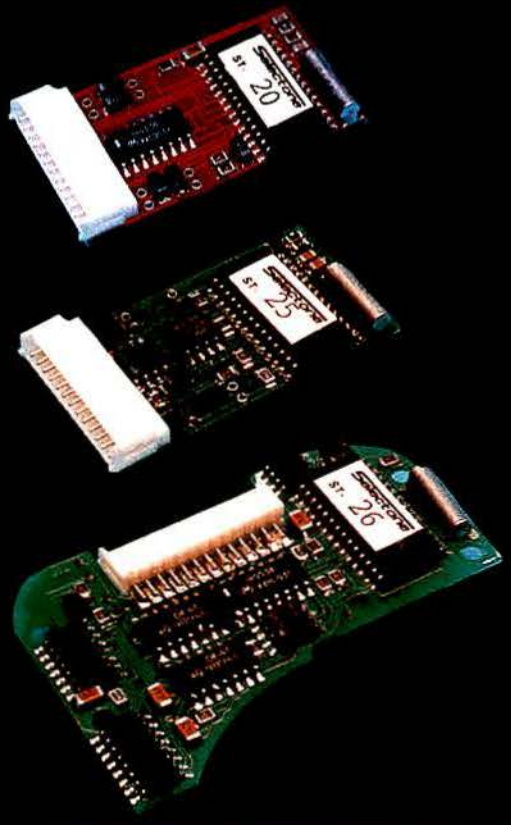
The subjective voice quality expected by telephone users is called "toll" quality.

Table 1—Voice coding parameters.

BIT RATE (KB/S)	MILLION INSTRUCTIONS PER SECOND	DELAY (MS)	QUALITY	EXAMPLES
64	.01	0	Toll	PCM
32	0.1	0	Toll	DECT/CT2
16	1	25	Communications	Fujitsu chip set
8	10	35	Communications	Cellular IS-54
4.8	100	35	Communications or Synthetic	IDEN
2.4	NA	NA	Synthetic	NEC Secure Voice
0.5	NA	NA	Synthetic	Formant vocoder

NOW AVAILABLE
Plug-In Scramblers for
Motorola SP50/CP50

THE PRIVATE COLLECTION
AFFORDABLE VOICE ENCRYPTION



Anyone - eavesdroppers, competitors, news media or common criminals - has access to most two-way radio communications. That's why Selectone's new line of voice encryption modules are such a vital component in any mobile radio system. And our "Private Collection" of compact encryption devices doesn't represent a big investment on your part. Depending on the level of security required, Selectone offers two encryption types: basic 8-code speech inversion, or a proprietary, digitally-controlled rolling code system with over 4 billion code keys.

- **ST-20 INVERSION SCRAMBLER** is our lowest cost system. Measuring only 1.5"L x 0.85"W x 0.25"H, it fits easily in any radio and is virtually transparent to the end user.
- **ST-25 MOBILECALL℠ ENCRYPTION MODULE** is a digitally-controlled, high security module that can be field programmed (with ST-905 Programmer) to provide over 4 billion code keys. It is the same size as ST-20 and is compatible with most radios including the new Radius℠ GP300.
- **ST-26 MOBILECALL℠ ENCRYPTION MODULE** (for p200/HT600) is similar to and fully compatible with ST-25. It is especially configured as a kit for the popular Radius℠ p200 and Motorola HT600 and MT1000 portable transceivers.

℠ Radius and Motorola are registered trademarks of Motorola, Inc.; Mobilecall is a registered trademark of Selectone Corporation.

PHONE FOR FULL FACTS - 1-800-227-0376

Selectone

SELECTONE CORPORATION
23278 Bernhardt Street, Hayward, California 94545
PHONE: (510) 887-1950 FAX: (510) 887-4011
IN CANADA: EASTCOM INDUSTRIES (416) 850-2550

Circle (30) on Fast Fact Card

Dispatch radio users are accustomed to lower voice quality. There is no sharp transition between toll quality and communications quality, and the bit rate is only one factor. This table represents generalities rather than absolutes. It is not surprising that the sound of digital cellular at 8kbs and Motorola iDEN (integrated dispatch enhanced network, formerly *MIRS*, or Motorola integrated radio system) at 4.8kbs has evoked complaints about quality. New voice technology often passes extensive lab tests and yet fails to please a larger, more diverse public.

Designers of the Japanese personal handy phone, the United Kingdom's CT-2 (second-generation cordless telephone) and the European DECT (digital European cordless telephone) have all elected to use 32kbs adaptive delta modulation PCM for voice coding, thus avoiding possible complaints about poor voice quality.

The availability of specialized chips has made it possible to design systems with tremendous power and flexibility.

Delay in voice transmission

Another undesirable attribute of complex coding is *delay*. (Delay means the time between the moment a person speaks into a microphone and the moment the person's voice is sent as a digital signal. Remember, more processing is required with slower bit rates, and more processing time increases the delay.) The 35ms delays at low bit rates shown in the table add to other system delays and contribute to the problem of *echoes*. An echo is generated when the transmission reaches an unbalanced element in the network, such as a hybrid transformer.

If the delay is short, it sounds like sidetone to the talker and has no negative effect. (Sidetone is the talker's own voice as heard in the talker's handset. For example, telephone users expect to hear their own voices in the earpiece as they speak into the mouthpiece.)

Delays greater than 30ms create a "barrel" effect and may cause user complaints. This voice-compression coding delay is only one of several delays in a complete system. Total delays in digital systems may be in the hundreds of milliseconds when all the data-bus accesses are added to the coding delays. Very long delays combined with echoes cause talkers to hear their voices superimposed on the voice of the person on the other end of the line. The only way to cancel the bad effects of delay is by using echo-cancellation circuitry—which adds to the equipment cost. Echo cancellation becomes more difficult and more expensive as the echoes become longer.

Data transmission

In some respects, data transmission becomes more difficult with digital radio. In current SMR systems, modems can be attached to the mobile unit, and data can be transmitted over standard voice connections just as they are over a phone line. With digital modulation, data transmission is not so simple. The digital coding algorithms do not allow the use of standard modems. A special modem must be designed to apply digital codes to the radio symbols. The entire system must be set up to bypass certain steps required by voice transmissions so the data bits can move transparently.

Factors in designing new systems

The availability of specialized chips has made it possible to design systems with tremendous power and flexibility. Chips for implementing TDMA, CDMA spread-spectrum modulation, voice compression and many other functions are common. The challenge in designing wireless systems such as ESMR is now a complex combination of understanding the technology, the government regulations and the emerging standards. Some good systems that emerge will nevertheless become market failures because some larger entities will have cooperated in establishing a different standard.

Corporate activity in ESMR

Nextel Communications, Rutherford, NJ, has assembled the largest group of SMR companies. Upon completion of its network, the company will have more than 750,000 subscribers. For the most part, the individual SMR repeater sites in the Nextel group are operating just as they have in the past, with FM analog equipment. The migration to digital by existing users has been extremely slow because of a lack of any significant advantages and reported problems with the iDEN technology. The newest Nextel investor, Craig McCaw, has announced that the company will not focus on cellular or PCS telephone communications but

Creative Solutions In Test Instrumentation

IFR μCELL-100

Stellar Performance In Digital Phone Test Technology

The μCELL-100 provides an innovative approach to testing digital phones by combining rigid test capabilities established by industry with sophisticated multiple function operations. The instrument is housed in a compact, portable and easy-to-use package making it suitable for both portable and bench applications. Several modes of operation are available to provide increased security, through-put and productivity.

These include:

- Auto-Test mode.
- Manual tests of the transmitter, receiver and antenna system.
- ID mode for identification of the UUT's MIN, ESN, SCM, and Type (TDMA, NAMPS, AMPS).
- Setup mode for user defined pass/fail criteria, call processing parameters and printer output format.
- Results mode to view test results or output data to printer.

Included within the μCELL-100's various modes is a myriad of features to enhance the instrument's ability to verify proper operation of a TDMA cellular phone. Some of these features include:

- VSELP encode/decode.
- π/4DQPSK constellation.
- Authentication response verification.
- Alert Info (Caller ID).

On the bench...

...in the service bay.

- Flash Info (Message Waiting).
- Performance plots of transmitter power, receiver sensitivity, observed BER and VSWR.
- Memory for storing setup configurations.
- Security protection for sensitive UUT and test set parameters.

Compare size, performance, features and price of the μCELL-100 and you'll agree it is the logical choice in TDMA instruments. For more information or a demonstration, contact IFR Systems today.

1-800-835-2352

ifr®

CRAFTED WITH PRIDE IN USA

IFR SYSTEMS, INC.
10200 West York Street
Wichita, Kansas 67215-8935/ U.S.A.
316-522-4981 / FAX 316-522-1360

HELIAX® Coaxial Cable

Andrew Innovation...

At thousands of sites in hundreds of locations around the world, you'll find Andrew innovation everywhere. That's because Andrew offers everything you need to build the highest quality transmission line system.

In addition to HELIAX® coaxial cable, Andrew also offers a complete line of connectors, cable assemblies and accessories. Each is designed and tested to reduce intermodulation (IM) and optimize the mechanical and electrical performance of your entire transmission line system, top to bottom, inside and out. ***Andrew Innovation... Put It to Work for You.***

CONNECT IT

Andrew offers a wide variety of connector configurations and interface types including 7/16 DIN, 4.1/9.5 DIN and Type N connectors to accommodate any installation. Popular new designs feature fewer component parts providing faster, easier attachment and lower levels of intermodulation.

PROTECT IT

Andrew surge protectors, grounding kits and related components provide you the highest level of lightning protection available on the market today. ARRESTOR PLUS™ Premium Surge Protectors incorporate advanced lightning protection into the high quality design of a HELIAX® connector providing a single, integrated, high performance, low IM component. Arrestor Plus eliminates separate components within your system and provides true multi strike capability delivering a cost effective, reliable, easy to install, no maintenance product.

Microwave & Base Station Antennas

HELIAX® Cable Assemblies

Accessories

It's Everywhere

Towers • Shelters • Pressurization

SECURE IT

Transmission line installation is fast and easy with hangers designed exclusively for HELIAX® cable. Hanger Blox™ Coaxial Cable Hangers make the most efficient use of available space by arranging cable into compact, orderly units. Fast installation of multiple runs of coaxial cable is performed by using standard tools. These versatile cable hangers are durable and stackable providing all climate integrity and clean appearance. Snap-in and butterfly cable hangers and hardware are also available to facilitate cable installation in any application in seconds.

WEATHERPROOF IT

Complete your installation with a choice of weatherproofing kits from Andrew. 3M™ Cold Shrink™ Weatherproofing Kits are the easy way to seal connectors from the environment in seconds eliminating the need for time consuming, frustrating tapes and mastics. Cold Shrink provides a long lasting, secure moisture barrier for cable connections and jumper-to-antenna connections with Type N or 7/16 DIN connectors.

To learn more about Andrew Innovation, Call our Customer Support Center at ***1-800-255-1479 Ext 29****, or fax us at* ***1-800-349-5444.***

ANDREW

Andrew Corporation
10500 W. 153rd Street
Orland Park, IL U.S.A. 60462

Circle (33) on Fast Fact Card

RADIAX® Cable

will redirect the marketing of the company's wireless communications services to business work groups. This posture is far from what Nextel's executives previously described as a strategy for the company to become the nation's "third cellular provider."

Connectivity with PCS and cellular

It is not possible for two people to communicate via direct radio connections except when they use identical transmitter-receiver pairs within range of each other. It *is* possible to network different systems in an optimum fashion if connections are made properly. Connections between cellular telephones and SMR or ESMR telephones can be made using audio switching in the circuit between each telephone and its public switched telephone network (PSTN) access point. PCS telephones can be connected with other wireless systems in a similar fashion.

With the new FCC ruling that allows wireline telephone exchange companies that operate cellular systems to hold SMR licenses too, it may be common for a single owner-operator to supply and sell inter-system connectivity among cellular, SMR-ESMR and PCS systems.

Market acceptance of new services

Market forecasts are probably second only to weather prediction when it comes to mistakes. For example, Hutchison Personal Communications of the United Kingdom invested $100 million to build more than 800 PCS base stations there. Only a few thousand people subscribed to the service, and without some new market interest, this particular service will be a financial failure. At the opposite extreme is cellular telephony in the United States. Early on, AT&T predicted fewer than 1 million users by the year 2000. At the end of 1995, it will have nearly 20 million users. The Arthur D. Little consulting company has told its clients that half of all telecommunications traffic in North America will be wireless by the year 2000.

Construction costs form a large hurdle for PCS. Once again, according to an Arthur D. Little estimate, it will cost $6.3 billion to serve 7 million subscribers in a 300-square-mile area. It will cost so much because transmitters must be placed every 500 to 1,000 feet, and a massive switching infrastructure must be built for the network. The cost of obtaining frequencies by federal auction adds to the PCS woes. The use of earth-orbiting satellite relays has many technical advantages, such as the absence of terrestrial RF interference and signal-scattering problems, but it is also expensive.

Summary

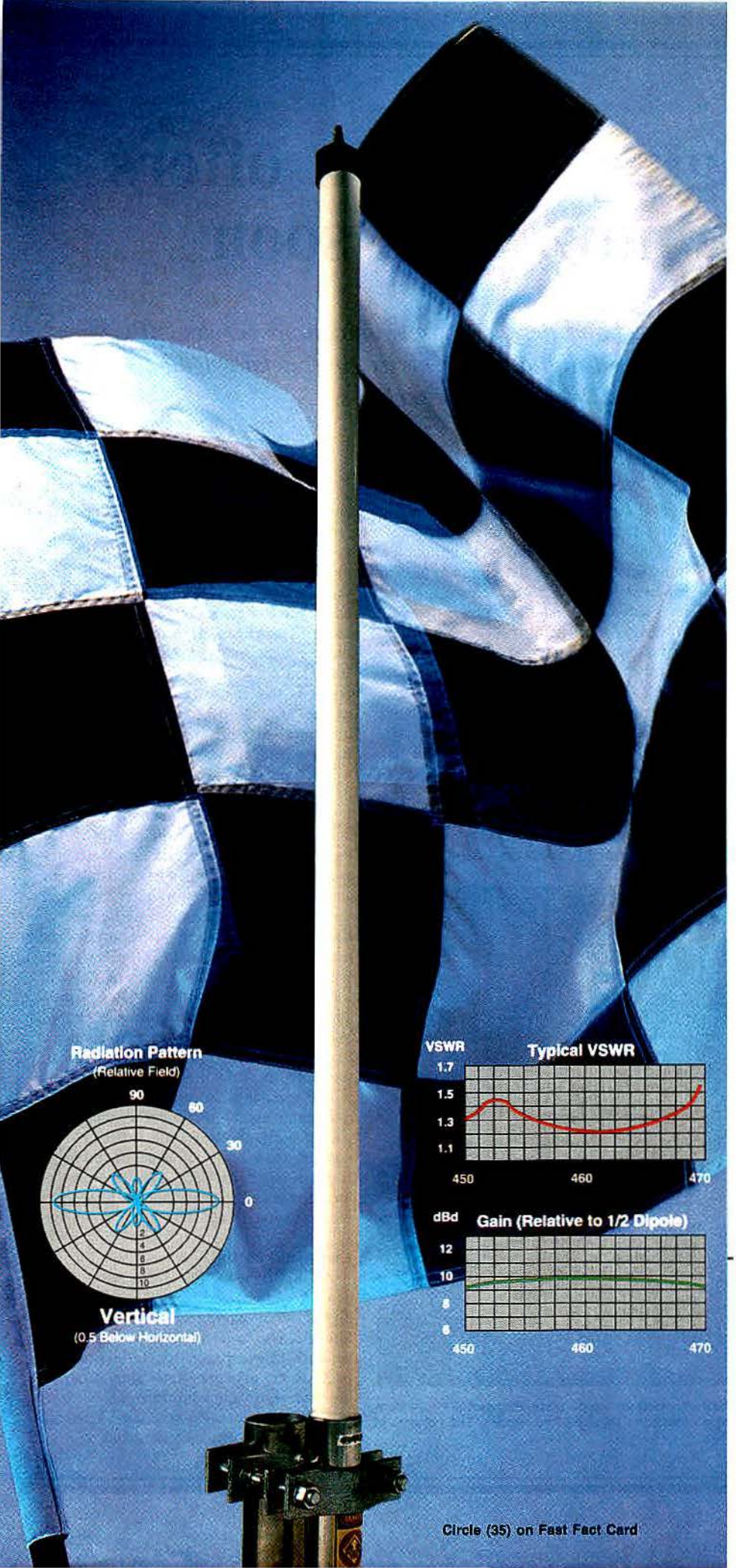
ESMR represents a method for improving and expanding SMR service, a method that is overshadowed by cellular telephony and by speculation about how PCS will be marketed. There is no standard ESMR technology, and the first rounds of trial systems have yielded poor results. Analog SMR will continue to provide fleet services for several years until ESMR demonstrates some clear advantages and technical successes.

Bibliography

Cellular Radio & Personal Communications, edited by Theodore S. Rappaport. ISBN 0-7803-2283-5.

Wireless Personal Communications, by Ron Schneiderman, ISBN 0-7803-1010-1.

"Selling Dispatch on Executive Row," *America's Network*, June 1, 1995.



Catch the winning spirit.

From the forge of world-wide competition comes the new Hustler *Spirit* series of vertical antennas.

Designed to win the race to provide the highest performance and durability possible, at a price that leaves others in the dust.

If you are driven to achieve a superior signal; if you need an antenna which is virtually impervious to wind and weather; if you want the best the world has to offer, catch our new *Spirit*-and win today.

Model Shown: HS9-45070
Also Available: Models from 136 MHz. to 2 GHz, including Land Mobile, Cellular, Trunking, SMR, Paging and PCN. All models available in a variety of gain configurations.

HUSTLER®

Beyond your Expectations

One Newtronics Place
Mineral Wells, Texas 76067
1-800-949-9490 • (817) 325-1386

YES, I'm interested in the new *Spirit*. Please send me your latest Professional Products catalog.

Name _____

Company _____

Address _____

City _____ *State* ____ *Zip* _____

Circle (35) on Fast Fact Card

New paging network offers voice now, data soon

Early use for so-called narrowband personal communications services (PCS) frequencies includes high-speed digital voice messaging, acknowledgment paging and two-way data services.

By Don Bishop

Paging Network (PageNet), Plano, TX, designed its current network using strong signals to ensure message delivery virtually everywhere within its coverage area and priced its service to build market share. The company's list of 5.4 million paging customers proves the success of its longtime strategy of keeping costs low and passing savings along to consumers. The company traditionally has entered markets already covered by other networks with the objective of covering those markets better by using twice as many transmitters.

Bishop is editorial director.

With narrowband personal communications service (PCS), the company adopts a new role in building a network to deliver services unlike those presently available. Using the additional capacity of its new frequencies, PageNet will deliver a variety of new services including two-way paging and two-way data services. Its first announced service, VoiceNow, will delivery voice messages to pager-size recorders. The service combines the mobility of paging with the convenience of an answering machine. In being the first to market the service, the company has the luxury—and the problem—of deciding how quickly it covers various markets and how much area it should cover.

Using a network of transmitters and receivers constructed for the purpose, PageNet is implementing voice paging on narrowband personal communications services frequencies. The network is designed to support two-way data services, too.

Using Motorola's Inflexion high-speed voice and data protocol, PageNet's narrowband PCS network will digitize voice messages spoken into the caller's telephone and carry them to the recipient's pager. The pager plays them back when the recipient wants to hear them. One of Inflexion's advantages to the network operator is that it uses a voice-compressing technology that makes it possible to transmit voice messages without consuming too much airtime.

The digital voice pagers contain a low-power transmitter that sends brief acknowledgments back to the network. These acknowledgments confirm receipt of the message by the pager and notify the network when the user has listened to them.

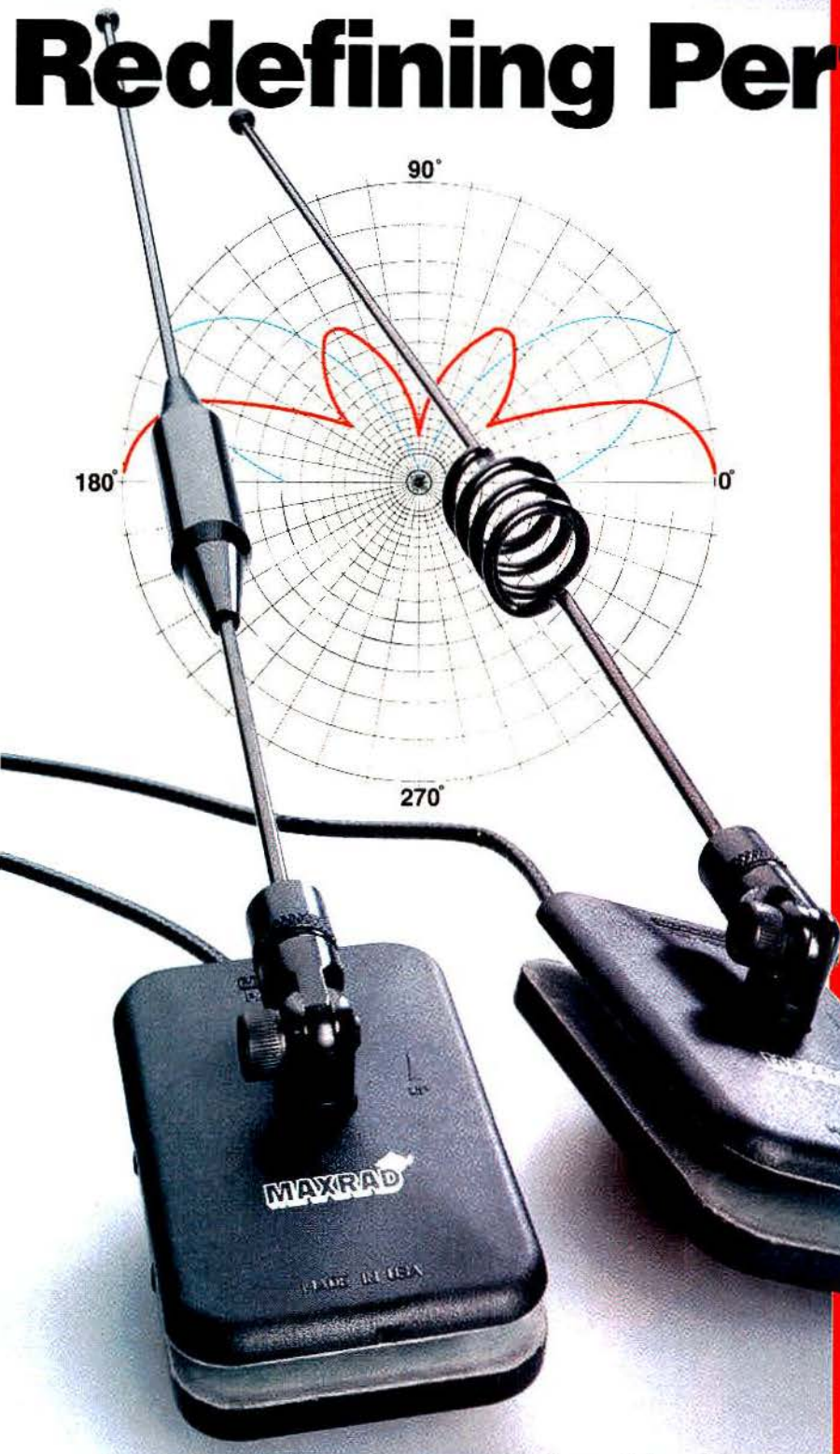
Messages remain stored on the pager until the user deletes them. One reason to delete messages is to allow additional messages to be received. The pager stores the equivalent of four minutes of audio. If a user has more than four minutes of messages, the network can store the excess. When a user deletes messages from a pager that is at its storage limit, the pager signals the network, and the network can send stored messages in quantities that make maximum use of the pager's storage capacity until all messages stored by the network have been delivered. If the pager is out of range, the network retransmits the message once the pager returns to the network coverage area.

End-balanced link

Alain Briancon, PageNet's vice president of systems and technology, describes digital voice paging as an end-balanced link, because a lot of data pass from the network to the pager, but little from the pager to the network—only simple signaling and registration information.

"Inflexion can support acknowledgment paging and two-way data communications,"

Redefining Performance



The MAXRAD State of the Art Microstrip Aperture Feed System Antenna:

- Transfers RF directly through the glass. This feature is so unique that a patent is pending.
- Is the most efficient glass mount antenna available. Up to 6dB of increased gain over competitive products means fewer dropped calls.
- Features an extremely rugged printed circuit construction; no moving parts to disintegrate and detune the antenna.
- Has a flexible ultra low profile design; easily conforms to automotive glass.
- Features specially drawn Belden small diameter cable (RG58/U equivalent).
- Incorporates a durable .100" diameter stainless steel rod that is fully adjustable and removable without tools.
- Includes MAXRAD's legendary quality, dependable service and prompt delivery.
- Is proudly designed, engineered and manufactured in the USA.

MAXRAD

State of the Art Antennas

Order: (800) 323-9122
4350 Chandler Drive • Hanover Park, IL 60103 • USA • Fax: (708) 372-8077 • Phone: (708) 372-6800

Circle (36) on Fast Fact Card

he said. "As services move toward two-way wireless data, then the proportion of outbound to inbound throughput reduces, but never becomes balanced. The amount of throughput on the inbound link (pager to network) increases, which after a while translates into an increasing number of network radio receivers. The number of network transmitters and receivers is proportional to the data rate at which the outbound and inbound messages travel."

To support voice and data communications, the network uses pagers with enough sensitivity to receive messages adequately and places fixed network receivers in the right locations to pick up returning signals from the pagers. As data communications products evolve, the network receiver data rate and the number of receivers may be changed.

Although the network is being designed to meet all data, RF and traffic requirements, supporting voice messaging presents the greatest technical challenge, Briancon said. "Voice communication is the most complex type of application that can be put on the network," he explained, "but it is the easiest for users to understand—and that is what makes it so appealing."

Coverage choices

With today's one-way paging, the way PageNet makes sure messages are delivered is to provide continuous coverage throughout a market area, along travel routes and in many rural areas. For example, continuous coverage along an interstate highway might require a high-power transmitter with a 2,000-foot antenna every 50 miles to make travelers receive their pages while on the road.

With the new Inflexion-based store-and-forward network, a gap in coverage does not prevent message reception. The pager registers itself when it returns to the coverage area, and any messages stored at the network are delivered. The technical approach is to cover the areas that make sense. Exceptions are made for practical reasons, though, such as extending coverage to the home of the president of a large account.

In large metropolitan areas, the new network's transmitters are placed to match existing local coverage with current one-way paging network transmitters. In rural areas, transmitter placement is more carefully considered in light of any competition.

Voice paging, long ago virtually replaced by numeric paging, stages a comeback in the form of a 'wireless answering machine,' a pager that stores voice messages for playback when the recipient wants to hear them.

PageNet's decentralized organization includes local general managers, sales

CELLGUARD™

It's the next best thing to being there. All the time.

The Narda CELLGUARD 8450 gives the cellular, SMR and paging industries everything you've been looking for in remote site continuous power and VSWR monitoring and haven't been able to get until now.

- Measures both transmitted and reflected power with guaranteed accuracy of ± 0.1 dB over 600 mW to 600W CW dynamic range.
- True RMS power measurement, whether one or multiple carriers or modulations.
- Accurately measures VSWR from 1.07 to 3.00 on a continuous range basis.
- Provides a form C relay alarm, responds to query, or transmits data continuously via internal microprocessor and RS485 bus control.
- Independent low power and software definable alarms.

If the question is vandalism, storm damage, transmitting power, or equipment problems, the answer is CELLGUARD.

Nothing else can do it all. Let alone so accurately.

For more information, call: (516) 231-1700. Or write: 435 Moreland Road, Hauppauge, NY 11788.

LORAL

Microwave - Narda

Circle (38) on Fast Fact Card

Visa and MasterCard accepted.

Photo courtesy of Nokia

managers and system managers who give the national network designers feedback about their customers' needs. "We don't have to design the network the way we did before," Briancon said. "The technology allows us to guarantee message delivery.

"When it comes to balancing capacity, penetration and coverage, there are no set rules."

Sometimes we use high towers to cover a large area. Sometimes we use low towers and more of them to cover a small area, a method that reduces coverage per site but that increases the system capacity."

Design challenges

PageNet uses the services of about 40 site acquisition specialists and 20 engineers to build the new network. One of their first challenges is to achieve a balanced design, meaning an equal number of network transmitters and receivers. "A balanced design is easy to design and to maintain," Briancon said. "It limits costs for leased telephone lines and for hardware from Motorola and Glenayre. The characteristics of such a design are not obvious, though. One has to balance the outbound power, place the antennas at the right height and with the right propagation attenuation from the right sites. The noise and signal level coming back from the pager has to be balanced. To achieve a one-on-one ratio with such a design is an interesting balancing act in multiple dimensions."

Another challenge has to do with cell reuse, which allows the same frequency to be used in other cells without objectionable interference.

"The first factor with cell reuse is the coverage area itself: how many miles of coverage," Briancon said.

"The second factor is penetration: how well can the message be received in an elevator shaft or basement, or how well can the message be received inside a moving vehicle? How much will bit error be above threshold?"

The third factor, Briancon explained, is the capacity. Every cell is different. In a downtown area, one tower covers a smaller cell than it would have to in a rural area. Both cells might, for example, include 10,000 people, but the area covered is quite different.

"We can set rules, but then we find that every configuration is slightly different."

"When it comes to balancing capacity, penetration and coverage, there are no set rules," Briancon said. "We can set rules, but then we find that every configuration is slightly different. Our PCS system manager is working closely to determine what each area really looks like; for example, how downtown Seattle differs from upper Manhattan. The process is more time-

consuming than we thought it would be. It is different from designing one-way paging, where there is a certain amount of design to place sites, then a reliance on simulcasting and high power to put signals everywhere. With the narrowband PCS network, we have to be more systematic."

PageNet has hired a number of designers with experience designing cellular telephone and packet switching networks because they are familiar with methods that work for the new network, Briancon said.

Identity

Briancon observed that, within the industry, the large service providers are well-known. On the other hand, the public is less clear about what companies provide paging service.

Even product identity might be clouded further by adding voice service. "Is it one-way paging with voice, or is it a wireless answering machine?" Briancon asked. "It has the value of paging: long battery life, roaming, a predictable bill, good coverage and a low price. But it sounds like a cellphone because you press its buttons and you listen to it. So there are some interesting marketing issues. But certainly our research shows that there is a strong base of potential users."

... acknowledgment paging, a confirmation given to a caller ... might not become popular.

Additional products are expected in 1996, perhaps offered in partnership with other companies. For example, computer chip manufacturers may want to offer products that can move data over the narrowband PCS networks, including PageNet's. The PageNet system can use either Inflexion or Reflex (another Motorola protocol) to move data.

With synchronized transmitters, the network has the flexibility to use only the closest transmitter to a receiver to send directed messaging. Extensive differentiation among the various system operators is expected.

Acknowledgment paging

PageNet's VoiceNow service acknowledges pager receipt of the message and the user's having listened to it — two forms of acknowledgment paging—but the acknowledgment is used only by the network in managing its own operations. The caller does not receive an acknowledgment.

Briancon said that another form of acknowledgment paging, a confirmation given to a caller that the called party's pager received a numeric message typical of today's paging traffic, might not become popular. "Do not dismiss the disruptive influence of a sender expecting a response right away because he knows you got the message," he said. "That expectation of a response might not be accepted lightly."

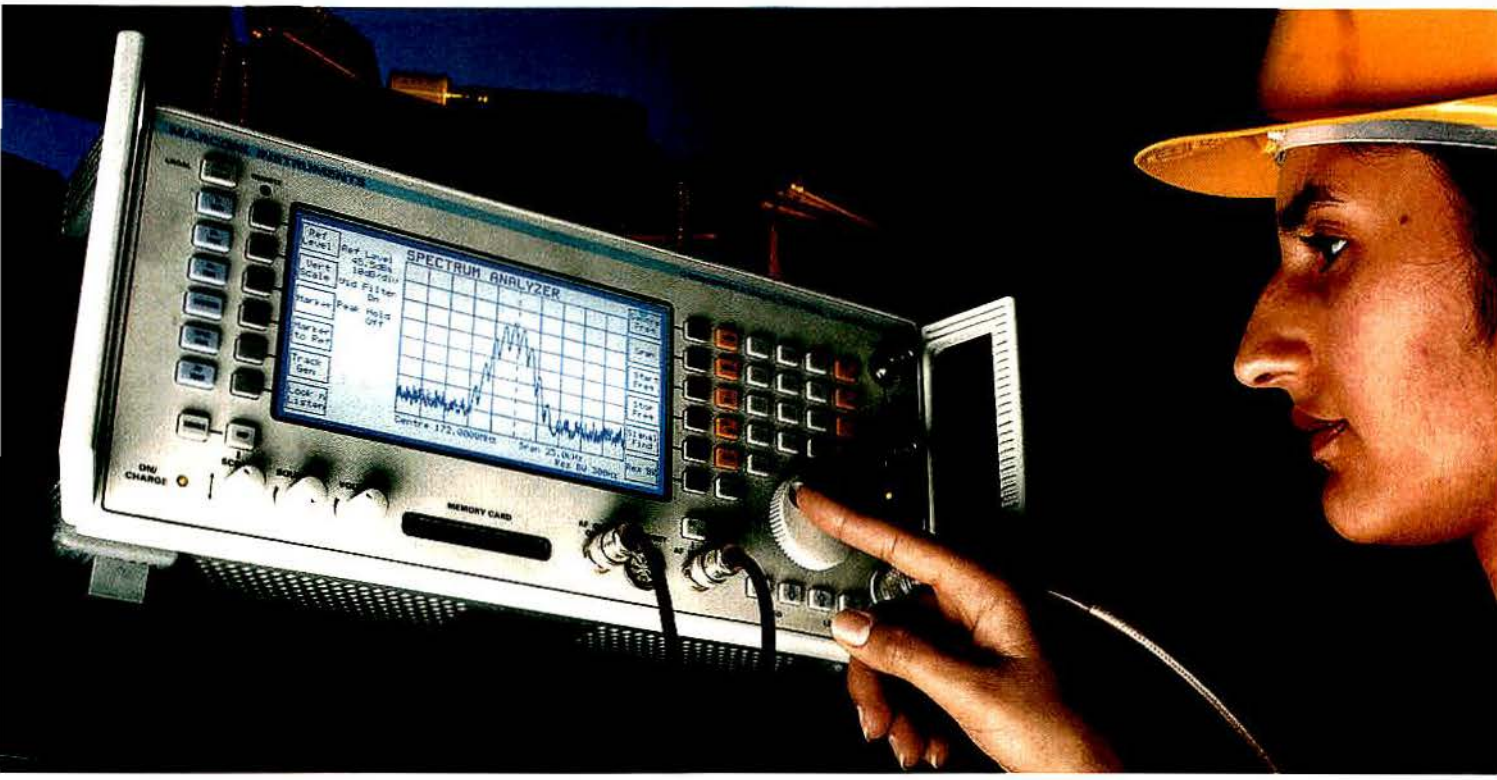
Briancon sees a better use for acknowledgment paging in the ability to send a response in the form of a short data message. "There is some value in sending a message to a portable user and that portable user answering the message," he said. "The caller might be requesting simple information, such as the price assigned to a real estate listing or a current interest rate or a meeting time."

"Are people willing to pay extra just for verification that their messages were received?"

The other form, an acknowledgment of a numeric page, might appeal to certain employers. It would reveal which employees are truthful when they say they missed a page or did not receive it in a timely fashion, Briancon said. "Are people willing to pay extra just for verification that their messages were received?" he asked.

It is a big step to build a new network to upgrade from one-way to two-way paging. Although the the new network will offer two-way paging and data services, PageNet's voice paging service is expected to help it to recover the network construction cost faster. "What the end market is going to be is unclear," Briancon said. "Fortunately, our network's flexibility will allow us to pursue the best alternatives as the market develops."

TestMate.



The new **Marconi 2945 TestMate**; the lightest, fully featured, radio test set available.

No matter what size your business, the new Marconi TestMate radio service monitor is the perfect partner. At just 11.4kg (25lb), TestMate is a complete bench of instruments in a single lightweight unit.

The easy to use interface has been developed from the proven Marconi 2955. Many of TestMate's standard features are options with other testers, including the fastest spectrum analyzer in its class.

A fast bright display update allows adjustments to be made with 'live' signals while a perfect combination of soft and hard keys provides flexibility and instant access to all functions.

TestMate makes cellular testing faster than ever and its rugged design makes it best for field tests as well as in the workshop.

Naturally the lightest, fully featured radio test set available is backed up by the best service support. For more about TestMate contact your local Marconi Instrument office.

Marconi
Instruments

Marconi Instruments Inc. 3 Pearl Court, Allendale, NJ 07401 Tel: (201) 934 9050/1 800 888 4114 Fax: (201) 934 9229
In Mexico: Telegroup S.A. De C.V. Tel: 5 398 3889 Fax: 5 362 0273

How to provide security at radio communications sites

A well-designed electronic security system helps to prevent a radio communications site from being burglarized and helps to protect it against problems such as fire, flooding and equipment malfunctions.

By Roald Steen

Most repeaters, microwave relay stations and base stations are located at sites that remain unattended much of the time. Good site security, therefore, is important and starts with good physical protection, including chain link fencing, barred windows and metal doors. Alarm systems alone do not *prevent* unauthorized entry, they only detect and report it. Response time varies, and a great deal of damage can be inflicted in less than five minutes.

Physical protection alone is not a deterrent, nor does it inform a site manager of other problems. Modern, microprocessor-based, electronic security systems can monitor many devices that protect the security of a remote site.

Electronic monitoring

An electronic security system has three main purposes:

- to discourage potential intruders who might attempt to enter the site.
- to transmit a report of an intrusion or system malfunction to an attended location from which the proper personnel can be alerted.
- to activate an audible and visible alarm at the site that informs the intruder that the entry has been detected, thus interrupting any further theft or vandalism.

Good site security, therefore, requires a communications link (to a monitoring site) in the form of a telephone line, or the baseband signal of a microwave link or one of the radio channels controlled at the site. Remember, though, that high-power radio equipment can wreak havoc with RF transmission of alarm signals. If this is the only available link for your security system, select and place the devices with a care to avoiding RF noise-tripping of false alarms. (False alarms that result in a response by a public safety entity are billed or fined in many communities. In some cases, the fines increase sharply after a minimum number of occurrences.)

Information from the various sensors at a site is communicated to the monitoring location through a microprocessor-based security control cabinet. There are wireless sensors that use low-level RF to communicate information to the control cabinet, but, again, wired sensors are more suitable for radio communications sites. RF-based sensors may be affected by a high-ambient RF environment.

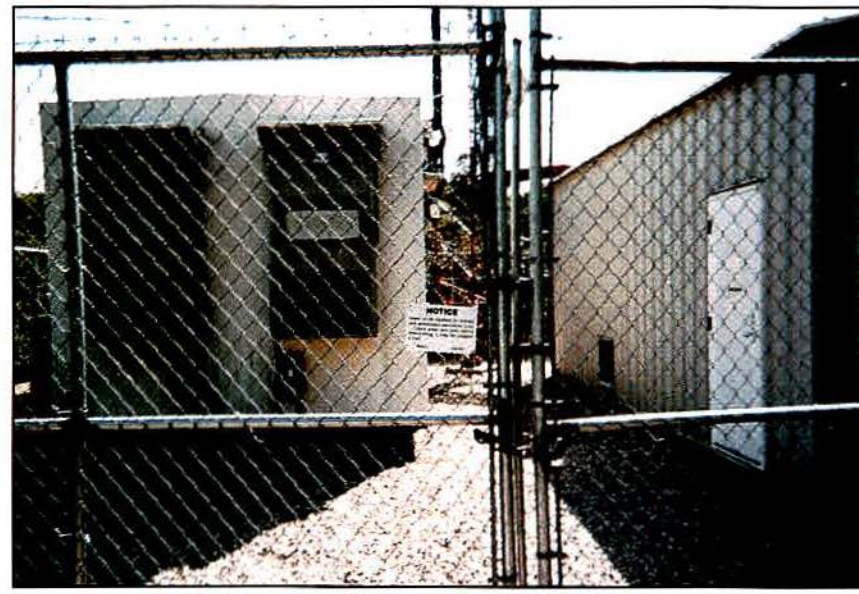
The microprocessor receives the alarms from all of the sensors that it is monitoring, evaluates each alarm and forwards the information to the monitoring site, which is generally an alarm company central station.

Unauthorized entry

If you want a site to be off-limits, say so. Warning signs that inform passers-by that the site is restricted and being monitored by an electronic security system reinforce the effectiveness of that system. Many would-be intruders stay away from sites protected by electronic security.

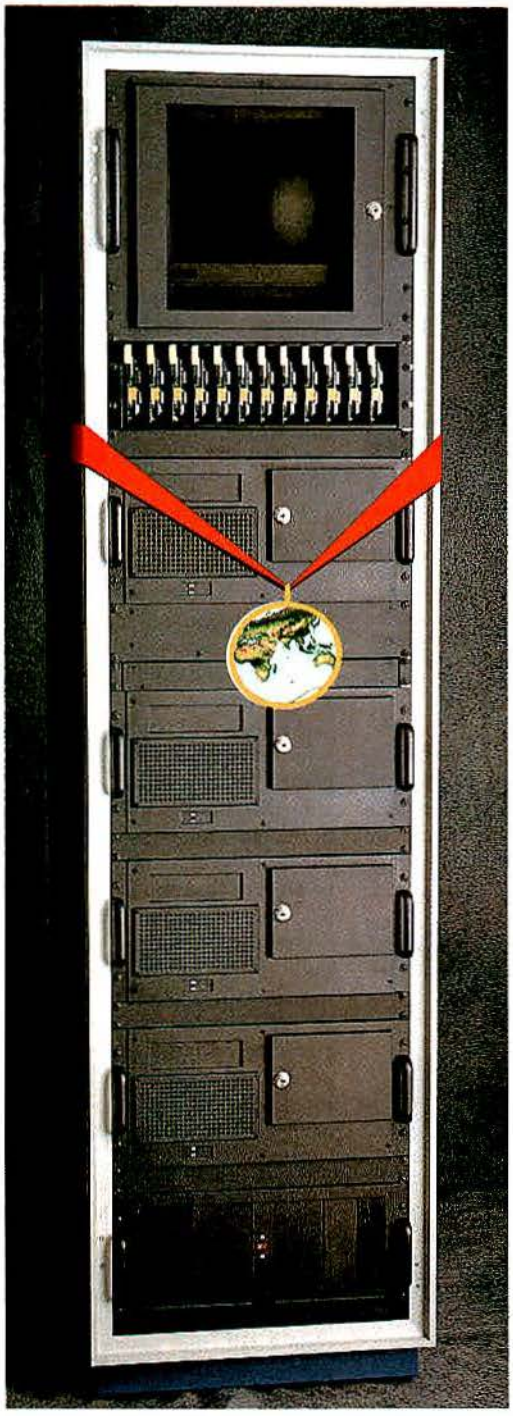
A number of devices have been developed to detect intrusion. The opening of a window or door can be detected by a magnetic-field sensor placed near a small magnet mounted on the door or window.

Windows can be protected by acoustic or seismic detectors. Acoustic sensors are positioned close to windows and sense sound waves that are characteristic of breaking glass. Seismic sensors are attached to the glass window and detect the



Most radio communications sites are remote or unattended much of the time. Site security starts with physical protection, including chain link fencing, barred windows and metal doors. ***Photo courtesy of PageTek, Raleigh, NC.***

Steen is an electronics instructor and free-lance writer. He has worked as a two-way radio technician, and he lives in Woodbury, MN.



PRISM II Paging Systems by TGA are WORLD CLASS

Designed to meet the standards used by international telephone administrations.

- E1 PCM telephone trunking
- MFCR2 telephone signaling
- Advanced 32 bit multi-processor technology
- Built-in high capacity PCM voice messaging
- Modular expansion for city-wide, regional or nation-wide operation
- Continuous Batch™ high efficiency digital paging
- Internal ACD for operator dispatch of alphanumeric messages and voice mail transcription
- High speed digital transmitter control
- Industry standard TNPP networking protocol
- Now available with TCP/IP & Ethernet access
- FLEX™, POCSAG and Golay formats
- Supports international character sets

TGA Systems, Inc.
Suite 150
3100 Medlock Bridge Road
Norcross, GA USA 30071-1429

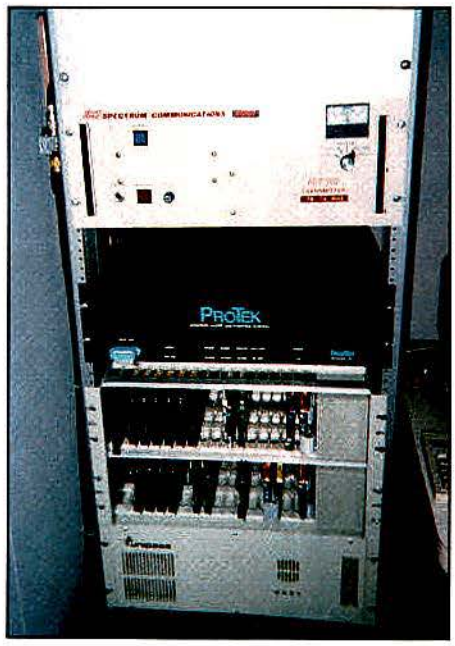
SEE US AT PCS '95
BOOTH #937

To learn more call:
+1-770-441-2100
FAX 770-449-7740

TGA Systems, Inc. **PRISM**

Shipping excellence for over 15 years

Circle (43) on Fast Fact Card



Information from the various sensors at a site is communicated to a monitoring location through the microprocessor-based security control cabinet. The control center can be rack-mounted with other site equipment (left) or placed in a separate control box (above). It receives the alarms from all of the sensors that it is monitoring, evaluates each alarm and forwards the information to the monitoring site. *Photos courtesy of PageTek, Raleigh, NC.*

internal shock wave frequencies associated with breaking glass.

Insect screens can be protected by special security screen with a pattern of thin, embedded conductors. When one of the conductors is cut, an alarm is sent.

Passive infrared (PIR) receivers are the most-used intrusion detectors in modern electronic security systems. They are more sensitive and discriminating than ultrasonic sensors. Still, the many heat-generating systems at a communications site may cause a PIR to issue false alarms. For unstable environments, dual-technology sensors, which combine PIR with ultrasonic or microwave sensing, may be used. When two technologies sense an intruder, a false alarm is unlikely, although using dual sensors does increase costs.

Site safety and operations

Although security against intrusion is important, other security and safety functions are of interest in a remote communications site.

Fire detection is foremost among these functions. The site should include one or more fire sensors connected to the microprocessor-based control cabinet. Fire sensors should provide separate and clear signals to the central station that they represent "fire" and not merely another burglar alarm zone.

At communications sites in buildings with automatic water sprinklers for fire control, flow switches are used to indicate that the sprinkler system has been activated and is pouring water onto a fire—or the floor. This can help to limit or prevent flooding that may be caused by a sprinkler system malfunction.

Systems should be able to report not only alarms but also their own internal malfunctions. Wire breaks or shorts should be detectable by a supervised circuit. The system should be capable of reporting an electric power failure to the monitoring site, and it should have a rechargeable back-up battery.

Some sites include a sensor that detects a drop in site temperature below a preset value. Many sites have heaters to maintain a temperate ambient temperature so that batteries and equipment operate in the best possible environment, and crystals remain stable. If the heating system should fail, this sensor sends an alert to the monitoring station. Similarly, a sensor that sends an alarm if the temperature rises above a certain level can report an air conditioning malfunction.

The monitoring site

With all of these security devices, sooner or later an authorized visitor may trigger a false alarm. When this happens, the visitor must call the monitoring site immediately to explain the accidental triggering of the alarm.

Many mobile radio companies monitor their remote sites at their own dispatch location that is attended around-the-clock. This self-reporting may reduce false alarm fines, but response also may

WORLDWIDE, GLENAYRE ACTIVATES MORE PAGERS THAN ANY OTHER INFRASTRUCTURE PROVIDER.

POCSAG ERMES APOC FLEX™ ReFLEX™ InFLEXion™

No matter what the protocol, you can rely on Glenayre infrastructure to deliver the message. For over twenty years, we have dedicated our resources to evolving reliable wireless infrastructure equipment. Glenayre's radio paging switches, transmitters and transmitter controllers serve as the backbone for more paging networks than any other manufacturers'. To ensure leadership in this dynamic market, Glenayre's Wireless Messaging Group is dedicated to advancing our customers into the next phases of high-speed paging including two-way and other Narrowband Personal Communications Services (NPCS). That is why today, over 30 million paging subscribers trust Glenayre to deliver the message.

Glenayre®

WIRELESS MESSAGING GROUP

For more information contact: Glenayre: Dept. RT-42, 4201 Congress Street, Suite 455, Charlotte, N.C. U.S.A. 28209
USA (800) 543-2382, International (360) 332-1302, FAX (360) 332-1403.

Glenayre engineering, manufacturing and customer service are registered to ISO 9001.

become lax and unpredictable. The appeal of saving some money in eliminating false alarms may result in poor protection and passive encouragement of careless use of the system.

Even a city or county emergency communication center has to plan who is going to receive, supervise and react to the center's own transmission site alarms and trouble signals. The center's personnel may be too busy with their regular duties to monitor the site.

Generally, private central alarm stations should be used for monitoring as well as for installation and maintenance. This is a particularly good solution if the number of people with authorized access to the site is small and controllable. The more people come and go, the greater the probability that false alarms will occur. A central alarm station is monitored around the clock by operators who are trained to alert law enforcement agencies, fire departments and others when their help is required.

Some electronic security systems do connect directly to a public safety emergency communications center, but in most cases direct connection is restricted to sites with especially high security needs, such as hospitals and banks. Other electronic security systems must connect to a central alarm station or similar monitoring point to screen out false alarms and other alarms that do not require public safety services.

Signs that inform passers-by that the site is being monitored by an electronic security system reinforce the value of that system. Many would-be intruders stay away from sites protected by electronic security.

The central alarm station does not have to be in the vicinity of the site. Various central alarm stations monitor sites nationwide. They use toll-free telephone numbers for their services. The automatic dialer that is part of a microprocessor-based alarm transmitter can be programmed with the telephone number.

When an alarm is detected, the nationwide central alarm station uses long-distance telephone service to call the law enforcement agency or fire department nearest to the site or other local individuals who can assist. A recent advance in alarm service is provided by S.A.N.T.A., a communications protocol developed and promoted by the Central Station Alarm Association. With S.A.N.T.A., central stations can communicate with 9-1-1 centers via computer-to-computer messages to those agencies' computer-aided dispatch (CAD) systems.

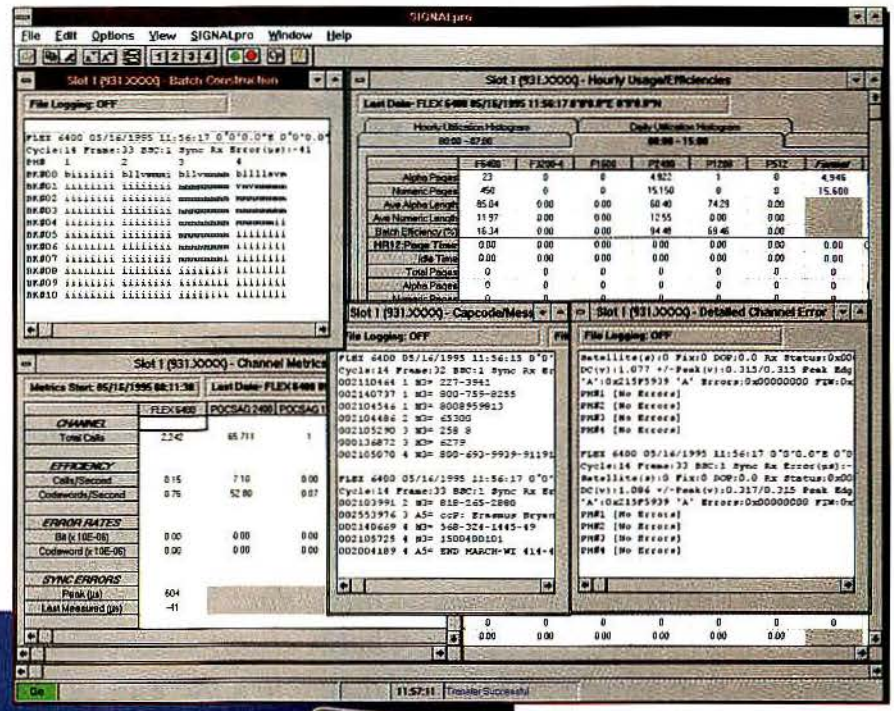
Site security is important for mobile radio communications systems, whether the site is at a remote mountaintop or in a building with heavy traffic. A well-designed electronic security system prevents the site from being burglarized and helps to protect it against other problems such as fire, flooding and equipment malfunctions.

SIGNALpro™

Your Window to Advanced Messaging℠

SIGNALpro is part of a system for the real time reception, demodulation, decoding, display, and file logging of radio paging messages and channel metrics. The system consists of a paging channel receiver, a SIGNALpro data analyzer, and a Windows capable personal computer (PC). RF signal reception and demodulation are performed by a local receiver such as a modified FLEX pager, a scanner (modified), or a communications test set. SIGNALpro accepts the demodulated audio from the receiver and performs the paging format decoding and detailed signal analysis. SIGNALpro and the PC transform the paging data into meaningful channel information. Display windows can be opened that provide channel error detail, batch construction details, call and usage summaries, as well as each capcode and message. SIGNALpro provides extensive signal and data analysis of the received paging signal. Data and signal analysis compliment your existing RF analysis tools (communications test set, RF signal strength meter, etc.) to provide you with a comprehensive set of test and measurement products. SIGNALpro can be used to better manage and troubleshoot existing channels, and has proven to be an invaluable tool when adding FLEX to a new or existing channel.

- Monitors up to 4 paging channels
- PC based Graphical User Interface (GUI) operates in conjunction with Windows 3.1 (or higher) providing a point-n-click menu interface for manipulating display windows, file storage, printing, and parameter changes
- Detailed channel error display provides real time bit error analysis and determination of the peak edge misalignment
- Synchronous receive time information provides error analysis of FLEX transmission boundaries



- Channel metrics display summarizes critical data such as bit error rate, codeword error rate, and channel call rates for each format and data rate
- Hourly Usage/Efficiencies display provides detailed information about average message length, batch efficiencies per format and data rate, channel utilization, and more
- Internal GPS receiver option
- Capcode/Message summary can be filtered by capcode(s) and by words, message fragments, character combinations, etc.

ADVANCED SIGNAL

301 Oak St., Suite 5-0
Quincy, IL 62301
(217) 224-2387
FAX (217) 224-2075

Radio system interference: Co-channel and intermod

Some apparent radio communications systems malfunctions might be traced to interference problems. Here are explanations for possible natural and man-made causes.

By Todd Ellis and Jack Curtis

Two types of interference affect radio communications, regardless of frequency: unwanted signals from other users sharing the same frequency (co-channel interference) and the interaction of other signals that may produce an unwanted signal on the receiving frequency (intermodulation interference or "intermod").

Two factors account for the majority of co-channel interference problems: marginal geographic separation and natural phenomena, including weather and solar activity.

Geographic separation

Some frequencies are designated for exclusive use in a given coverage area or radius from a transmitter site by a single licensee. Exclusive licenses are issued to some government users, to common carriers and to certain public and private systems above 800MHz. On some occasions, co-channel signals originating outside the protected area may reach into the protected area. Even so, exclusive licenses help to minimize co-channel interference.

Many users have licenses for shared frequencies where signals from two or more organizations' systems overlap. Depending on the population density of the area in question, tens or even hundreds of users may share a given frequency within ordinary reception distance of one another.

Selecting alternative frequencies to increase the geographic separation on either exclusive or shared channels may reduce the likelihood of interference, although variations in terrain, weather conditions and equipment performance may increase interference.

Ellis is manager of business development, and Curtis is systems engineering manager at Teletec, Raleigh, NC. Teletec is a microwave, RF fiber optic and video systems integrator that manufactures VHF-UHF high-tier mobile radios and base stations.

Weather

Temperature inversion — Sometimes air layers with different temperatures form above the earth. For example, a layer of cool or warm air may be trapped under a layer with the opposite temperature. The boundary between these layers can extend radio range temporarily, causing co-channel interference to distant users. VHF and UHF radio signals traveling at angles to the earth may reflect at the boundary and return to the earth's surface many miles away without being weakened by surface features. Temperature inversions occur most often near a body of water that cools or heats air near its surface.

When a cool or warm layer of air is sandwiched between top and bottom layers of opposite temperature, a radio signal may enter this "duct" and ricochet between air masses until it reaches the end of the contrasting layers.

▶ *Ducting* — When a cool or warm layer of air is sandwiched between top and bottom layers of opposite temperature, a radio signal may enter this "duct" and ricochet between air masses until it reaches the end of the contrasting layers. Radio range may be reduced beneath the duct, yet strong signals may be heard from several hundred miles away in a particular direction. Ducting most often occurs around bodies of water that may cool or heat the lower layer of air dramatically.

Solar activity

▶ *Sporadic* E — "Sporadic *E*" interference or "skip" occurs when solar radiation helps to concentrate ionized air molecules in the E layer of the ionosphere, an upper atmospheric layer. Radio signals, including VHF and sometimes UHF, can reflect from this layer and return to earth as far as 1,200 miles away. Sufficient ion concentrations happen at any time, but mostly during daytime hours and between mid-morning and early afternoon. Sporadic *E* interference may last from a few minutes to as long as five hours or more. Days or weeks may pass between occurrences.

▶ *Solar flares* — When the sun expels plumes of gas known as solar flares, ionized particles may be propelled toward the earth. When they reach earth in sufficient quantity, they disrupt its magnetic field and ionosphere. Usually, these disruptions interfere with shortwave radio communications and leave VHF and UHF communications unaffected. Sometimes the charged particles increase the possibility of sporadic *E* interference.

An awareness and understanding of how weather and solar conditions can affect VHF and UHF radio communications is important to analyzing interference problems accurately. The influence of solar flares is seen worldwide, and weather-induced interference is seen near lakes, coastal areas and along the Mississippi River.

Possible cures

Co-channel interference may be reduced to a tolerable level or eliminated by changing frequency, using directive antennas or by using coded squelch.

Extra! Extra! Extra sites on building tops and mountain tops.

The front page news is Meridian's continued growth in *both* building top *and* mountain top antenna sites. The follow-up story is our commitment to meeting your expanding needs—just tell us what you need and we'll respond. Our loyal readers are already familiar with our library of prominent antenna sites that stretches from the Mexican border to Santa Maria.

And when it comes to site features, we wrote the book. For example, we're installing continuous site monitoring to bring in reports on temperature, electricity status and other vital statistics.

Our state-of-the-art facilities include features like a new high-security access system, stand-by power, air conditioning, and comprehensive site maintenance. And all sites are continually being upgraded.

To locate your equipment at one of our sites, or for more information, you can always count on Jack and Rich Reichler to go the *extra* mile. For starters Meridian will send you a FREE Pocket Site Selector and Organizer when you call **(800) 400-SITE.**

FREE!
Filled with essential info and California sites

Great sites, great service, since 1956.

Meridian Communications

23501 Park Sorrento, Suite 213A, Calabasas, CA 91302-1355
(818) 222-5655 • (800) 400-SITE (7483) • Fax (818) 222-2857

Circle (48) on Fast Fact Card

SEE US AT PCS, September 21-23, 1995, Booth #700.

▶ *Frequency change* — The best solution, though perhaps the most expensive, is to change to a frequency with fewer or no nearby co-channel users. In highly populated areas, there may be no such frequency available.

▶ *Directional antennas* — Using directional antennas pointed away from the source of interfering signals sometimes is quite effective, especially when the desired coverage area is at a right angle from the undesired transmitter. At 90° from its optimum orientation, a directive antenna offers maximum attenuation of the undesired signal and maximum forward gain toward the target coverage area.

▶ *Tone squelch* — Although listed as a solution, tone squelch (continuous tone controlled squelch system, or CTCSS) only prevents interference from being heard, it does not eliminate it. Masking interference in this way may give adequate results, though, with interference only strong enough to be annoying, yet not strong enough to override desired communications. CTCSS uses a single audio tone between 67Hz and 250Hz to control the receiver squelch. The squelch silences the radio when no desired signal is being received, freeing the operator from hearing most background noise, interference and other users' communications. When in use to make or respond to a call, though, the radio is unsquelched, and any interfering signal may be heard along with the desired transmission.

Trunked radio communications systems offer privacy and interference control similar to CTCSS. Yet, if co-channel interference is present on a trunking system, the interference may be inaudible only when the system is idle, again similar to CTCSS. Higher radio frequencies are less affected by weather and solar conditions than VHF and UHF frequencies, so trunked systems at 800MHz and 900MHz have less interference caused by the weather and the sun. On the other hand, trunked systems require more accurate design engineering.

Higher radio frequencies are less affected by weather and solar conditions than VHF and UHF frequencies...

Intermodulation

Although co-channel interference almost always is caused by signals from other users, intermodulation may be caused by one's own equipment. It results when radio signals on two or more frequencies mix to produce signals on additional frequencies. For example, when frequency A and frequency B mix, they produce the following frequencies, among others: $(A + B)$, $(A - B)$, $(2A + B)$, $(2A - B)$ and $(2B - A)$.

If a third frequency is added (frequency C), many new combinations are now possible: $(A + B)$, $(A - B)$, $(A + C)$, $(A - C)$, $(B + C)$, $(B - C)$, $(2A + B)$, $(2A - B)$, $(2A + C)$, $(2A - C)$, $(2B + C)$, $(2B - C)$, $(2B + A)$, $(2B - A)$, $(2C + A)$, $(2C - A)$, $(2C + B)$, $(2C - B)$, $(A + B + C)$, $(A + B - C)$, $(A - B + C)$, $(A - B - C)$, etc.

Because the energy content of RF signals (as opposed to broadband microwave) tends to be greater for odd harmonics,

For us, there's no escape from this cell...

And we'd like you to join us.

We're locked into only one cell. The best!
We don't offer a top-of-the-line battery with a premium battery cell. That's because we use premium battery cells in all the rechargeable batteries we manufacture. *We pay extra* for our quality cells to make sure you get more charge cycles, more capacity and greater reliability with every battery.

Someone else gets the rest.
Cells can vary in power, impedance and performance. Motorola selects the most uniform, highest energy-producing cells available that have the best of these characteristics. We pass the highest performers on to you in every battery we make.

Here's the key to our cell.
Motorola measures capacity and performance across its premium cells and publishes their average rating. We always meet our published spec. And, in most cases, exceed it!

Other battery manufacturers may select only the highest performing cell in a lot they purchase and publish it as their average. On paper that may look good. In the field you're in trouble. Chances are you won't receive the talk time or battery life you expected and paid for.

Our cells give you protection.
For us there's no escape from quality. We guarantee every battery will perform to its advertised spec. With us, if we say our battery will deliver 1200 milliamp hours capacity (MAH), then that's what you'll get...

So join us! Motorola is absolutely your best protection for optimum talk time, all-the-time.

MOTOROLA
Americas Parts Division
1313 E. Algonquin Rd.
Schaumburg, IL 60196

Circle (50) on Fast Fact Card

intermodulation products such as $5A - 4B$ (9th-order intermodulation) can affect reception if they fall on a desired receive frequency. Intermodulation can be serious at locations where many transmitters and receivers may operate simultaneously.

Possible cures

Intermodulation can be eliminated or reduced in several ways. The best way is to select frequencies carefully, based on a thorough intermodulation study, to avoid frequencies with intermodulation potential.

Another method to attenuate the intermodulation is to separate the antennas associated with transmitters causing interference by a sufficient distance, either horizontally or vertically. Because land mobile antennas usually concentrate power at the horizon, vertical separation reduces interference more than horizontal separation.

Reducing transmitter power reduces intermodulation. Installing isolators or circulators, or both, to filter unwanted signals from entering a given transmitter prevents signal-mixing at its source. Selecting radio products designed with an appropriate amount of intermodulation suppression helps, too.

Another method is to restrict, either electronically or administratively, the simultaneous operation of the interfering transmitters. This approach may be acceptable with non-critical radio traffic, but it may impose unacceptable constraints on systems handling urgent communications.

Intermodulation is more likely to occur when two or more transmitters feed a single antenna than when each transmitter has its own antenna. Without filters such as isolators or circulators, the transmitters' signals mix when they are activated simultaneously. The mixed audio and distortion that results from particular combinations of active transmitters can render reception on affected channels impossible. On the affected channel, several voices may be heard at once, along with distortion and a squealing tone. Voice and signaling systems are typically rendered inoperable under these conditions. Other combinations of active transmitters may not result in intermodulation on that particular receiving channel.

Other interference sometimes mistaken for intermodulation is imaging interference.

Sometimes, well-engineered systems, free of intermodulation when first activated, can be affected by later installation of additional radio channels at the same antenna site. If adequate precautions are not taken when adding channels, the system may experience interference.

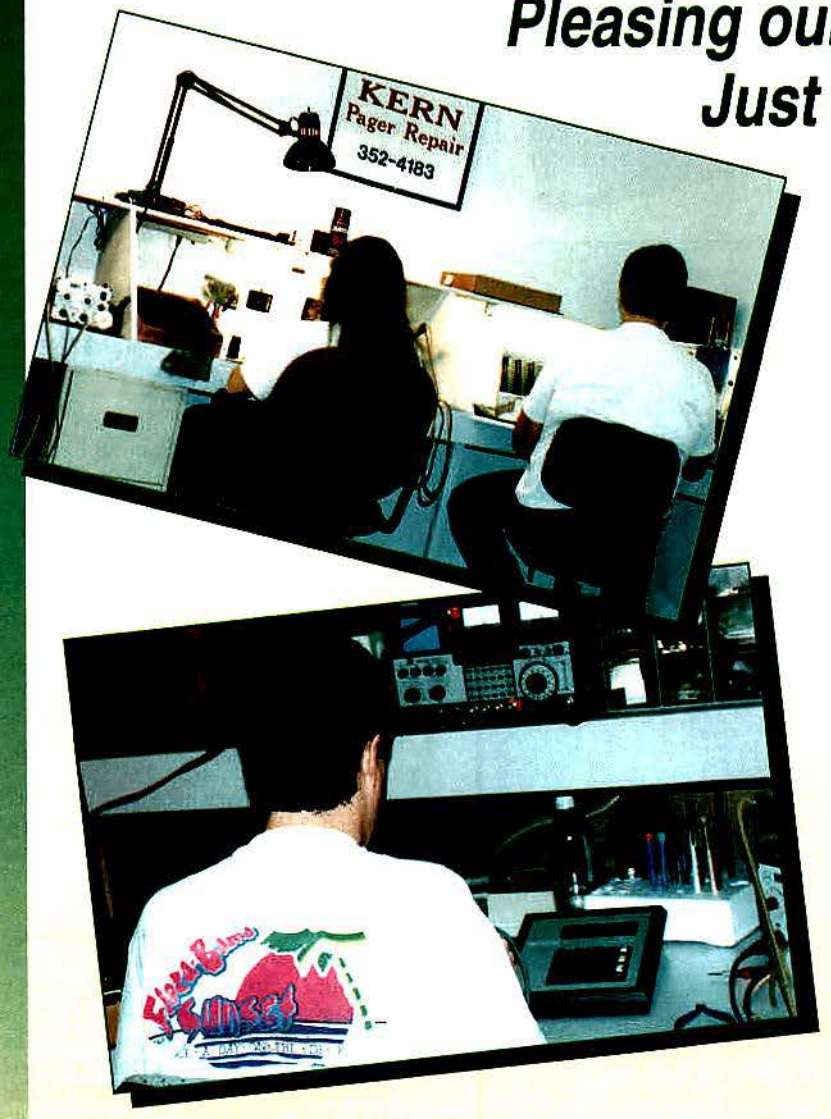
Imaging interference

Other interference sometimes mistaken for intermodulation is *imaging interference*. Quite often, when a receiver is overloaded by a nearby, high-power transmitter on another frequency, an interference signal—an image—appears directly on the receiver's tuned frequency. The solution is simple: Replace the receiver with another that has better image suppression. Nearby strong stations can and will overload a poorly filtered receiver.

It is important to know how to determine

NATCOM, INC./ KERN PAGER REPAIR

Quality is our Main Concern... Pleasing our Customers Just Comes Naturally



Quality Workmanship and Technology have brought us the Miracle of Communications. Quality repair and maintenance is a must to keep the lines of communication open. We offer a full line of services to keep your communications network running smoothly.

Quality, Reliability, Versatility & Affordability

NATCOM
INCORPORATED

834 Foley Street
Jackson, MS 39202
800-844-5376

KERN Pager Repair

5422 Carrier Drive, Ste. 205
Orlando, FL 32819
800-345-6067

Circle (52) on Fast Fact Card

the difference between intermodulation and images when troubleshooting interference. For example, a group of amateur radio operators near Raleigh, NC, all own a certain brand of scanner receiver. Each scanner shares a common attribute: It has a 21.4MHz IF and a susceptibility to image reception that is inherent with wideband receiver design. When tuned to 146.64MHz, they heard strong, unintelligible "intermod." A calculation revealed that 146.64MHz − 21.4MHz = 125.24MHz, a frequency close to the nearby airport's approach frequency. All of the interference-ridden scanners were within range of low-flying aircraft approaching the airport. Because the aircraft radios were transmitting in AM and the scanners are FM receivers, the interference was naturally hard to decipher.

Interference effects

As a result of co-channel interference, an effect called "capture," unique to FM equipment, may occur. When two on-channel signals are received, the stronger can overrride the weaker, momentarily taking over the channel, but with some audible distortion. When the ratio of signal strength is 3:1, significant distortion is heard. With a 5.5:4.5 ratio, distortion is so great that communication is almost impossible. The distortion usually is a buzzing or humming sound. A slightly off-frequency interfering signal produces an audible tone that adds to the already noisy distortion.

A ratio of 9:1 or greater makes it possible for the stronger signal to be understood. The stronger signal controls the channel, but when it drops, the other signal takes over.

On-channel interference and distortion may render scanning and on-channel signaling features inoperative.

Summary

Co-channel and intermodulation interference are serious problems that, if unremedied, can reduce or even destroy the usefulness of radio communications systems. Frequency assignments must be made carefully to minimize the likelihood of interference, and system designs should include both co-channel and intermodulation studies to identify possible problems prior to system implementation.

For existing systems with interference of either type, available alternatives should be evaluated before attempting a solution that might simply make the problem worse. Unfortunately, the possible cures for interference on an existing system tend to be more costly and often produce less than satisfactory results.

NORTHSTAR COMMUNICATIONS

Because money matters . . .

Call Us First.

In the world of communications, the failure of a radio system can put a company out of business. And in today's competitive world, everything revolves around communications. No one understands this better than the employees of Northstar Communications. From the simplest repair work to the most complex installation, Northstar Communications is able to meet all of your communications needs.

We offer a variety of services, including:

- Radio site repair work
- Cable maintenance service
- System design
- Complete turnkey installation

For more information or for a quote, please contact Jonathan Amonett or Harry Lewis at 1 (800) 606-7437.

Northstar Communications

15330 Anacapa Road, #3
Victorville, CA 92392
(619) 241-1950 • Fax (619) 241-1929

I'd like to thank... *everyone*

By Robert H. Schwaninger Jr.

Have you ever sat down to dinner in a nice restaurant and had the waiter come up to take your order, but before you've got a chance to ask whether the Happy Meal comes with fries, the person sitting next to you says something like, "Before we begin, I'd like to thank the waiter and his staff for preparing our meal for today. His efforts in the past have always resulted in fine culinary delights. I thank you, John, for the time you have taken in assisting us in this important function."

You look at the guy who just launched this soliloquy and figure he's a bit bonkers, but apparently harmless. But then the guy next to him says, "This meal has been a long time coming, and I have been assured that the kitchen staff and the waiters and even the suppliers who labor to bring us this food through the assistance of our fine restaurant have given special consideration to the public's every need."

Before anyone else at the table has a chance to continue this love fest, you fire your question at the waiter, "What are the specials?!"

The waiter looks around the table, then pulls out a sheet of paper and begins reading, "We at Chez Backslap would like to thank all of you for your participation in working with us to bring you and the public this meal. We believe that this food is both comprehensive and filling and will enable you, the diners, to move forward, not only in the gastronomy arena, but also in further endeavors to serve the public. Thank you."

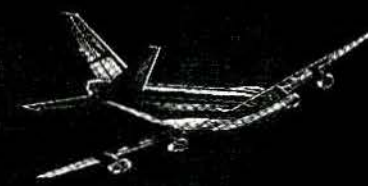
"B-b-but what're the darn specials," you whine, only to be cut off by another of your dining partners who says, "Thank you for your presentation. I'm sure we are all in agreement that the menu is one of the finest we've ever seen, and we would like to now vote on the matter of dinner. All in favor?"

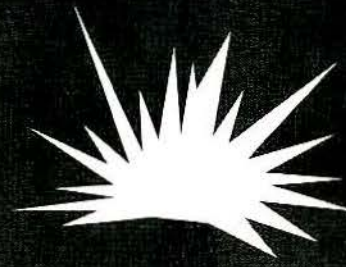
Your protest is drowned out by a chorus of "AYE!" and the waiter smiles, turns and walks away, leaving you wondering what is about to be served and whether it will still be wiggling when it shows up on your plate.

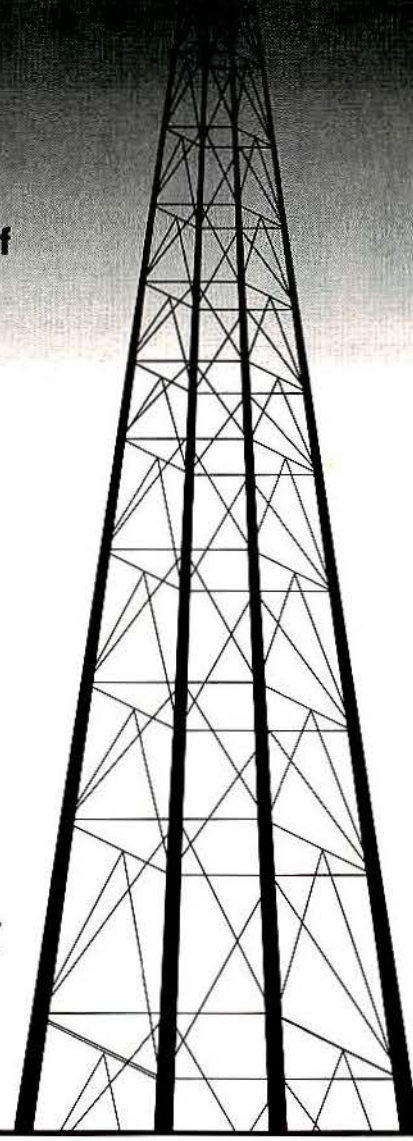
Schwaninger, *MRT*'s regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

It's Dusk.

Do You Know If All Your Tower Lights Are Working?







Communications site monitoring equipment to monitor the status of various alarm conditions such as:

- **Tower Lights**
- **Temperature Alarms**
- **Open Doors**
- **Equipment Alarms**

Automatically reports to a central computer for alarm notification.

HARK® Systems
WIRELESS COMMUNICATION SOLUTIONS

Hark Systems, Inc.
1801 Old Trolley Road, Suite F
Summerville, S.C. 29485
(803) 875-4480
1-800-367-4275
Fax: (803) 873-5277

Regulating technology

Did this ever happen to you? No? If it had, you might have noticed that the conversation sounded a lot like a formal Meeting (capital "M") of the Federal Communications Commission. Just sit in the audience and listen, and you will witness one of the most frustrating shows ever produced.

At a meeting, the commissioners introduce people in the audience whom they wish to commend for their fine service, then turn to the business at hand. At this point, a staffer takes up the microphone and explains that the docket, report, memorandum or paper vehicle of the day was prepared with the assistance of (compliment more staff) and that the results of separate meetings with the Commissioners' staffs (more compliments) have resulted in what they believe is a really terrific answer to many complex, difficult and brain-teasing things, the likes of which haven't been seen since Mrs. McGary tried to show you how to multiply fractions in the fourth grade. ("If you had one-eighth of an apple and a train left Chicago going south at 10 miles an hour....")

After the staffer is done complimenting the commissioners, their staff, the Bureau, the cooperating Bureau and each staff member who worked on the dockets since the last presidential administration, she pauses. This pause is often long enough to allow one of the commissioners to start complimenting the docket, the person who is presenting the docket and one lady she passed in the hall who was wearing a really nice outfit. Then the commissioners all vote "AYE," and it's on to the next item on the agenda, and the whole playlet starts again.

Meanwhile, you're sitting in the audience with a pad and two fresh pencils, a pen and three highlighters, ready to make copious notes about every substantive utterance made. The agenda item that drew you to the meeting (and which is always the last item discussed) has just been voted on, approved, adopted into law, and will affect about half your clients. But, you don't have a clue as to what in the Sam Hill just happened!

You know that they adopted the Order, but you don't know what it says. For all you know, they just voted to make Reed Hundt the Prom King! Not that he wouldn't look great in a powder blue tuxedo, but that's just not the point. The point is that by the time you get back to the office, the telephone's ringing because a client just heard that the commission finally voted on the item, and he wants to know what it says and means and what effect it will have on him. If you're feeling mischievous, you offer to send them your notes.

If you didn't know, there's a federal law called the Sunshine Act that requires the commissioners to meet only in public, subject to the intense scrutiny of the limelight. All of their comments are videotaped and recorded for posterity, so that we can sit at home and keeping playing the tapes over and over to make sure that no staff member got an unfair compliment. (The public will not tolerate faint praise.)

In consequence of the restrictions on commissioners meeting face-to-face to actually *discuss* pending regulation before acting on it, staff members become the conduits of communication. Commissioner A learns from staffer X what staffer Y said that Commissioner B would prefer—sort of third person once removed.

If you apply a little logic to this process, it quickly becomes apparent that the vote (the part we get to see) is just a formality. Everything had been decided before the commissioners walked into the room. If a particular commissioner thought the Order stank out loud, he already expressed his viewpoint beforehand and the repugnant language was changed. That way, the vote is almost always unanimously in favor of the item.

...It quickly becomes apparent that the vote (the part we get to see) is just a formality. Everything had been decided before the commissioners walked into the room.

This also explains why the commissioners don't need to have the staff tell them what's in the docket. They've read it and discussed it with their staff and the bureau and their doorman. By the time the staff introduces the item at the meeting, the only thing that is left to do is be polite and thank all of the little people who made the whole process possible.

So, with that in mind, I'd like to thank the people from Connecticut who wrote to compliment me about one of my columns. Their comments were insightful and helpful and really would improve the industry for all participants, including saving the public millions of dollars. In case you want to know what they said, I'll ask the federal government to publish their letters in the *Federal Register*.

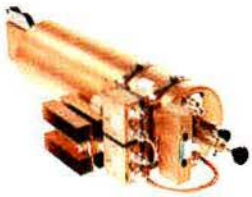
T-PASS® EXPANDABLE
TRANSMITTER & TRANSMITTER/RECEIVER
MULTICOUPLERS

In ranges of:
66-88 MHz
132-174 MHz
215-250 MHz
400-530 MHz
800-1000 MHz

Unsurpassed expandability. Inherent reliability and versatility. Superior cavity/ferrite transmitter multicoupler performance. The best long-term system engineering and product support.

T-Pass expansion channels to fit in a wide variety of system requirements...

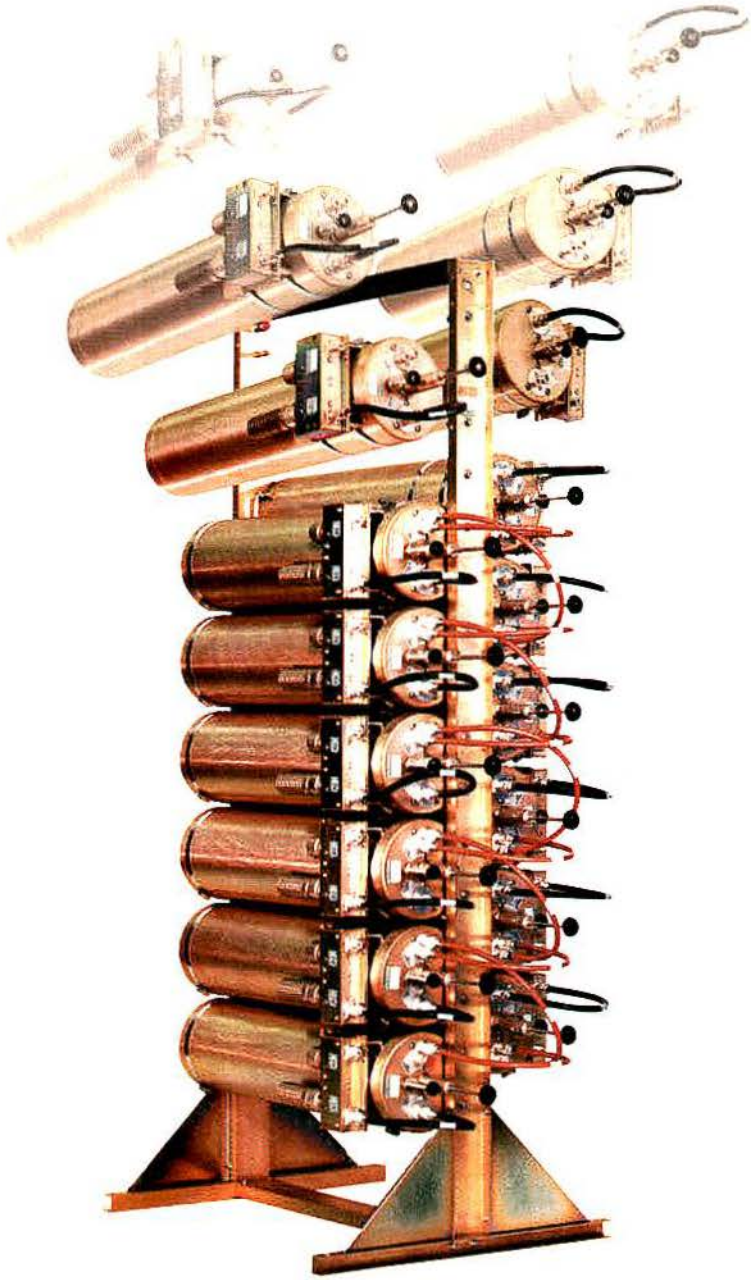
3-quarterwave for 800-1000 MHz 150W applications.

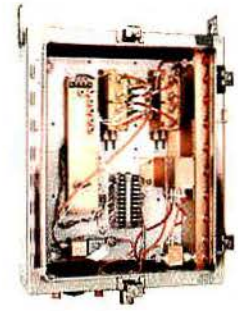


Fan-cooled, 5-quarterwave for close-spaced, high-power 800-1000 MHz applications.

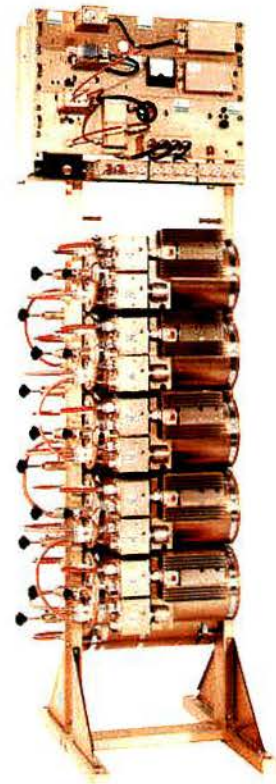
Ten-inch 3-quarterwave UHF, with 4" Vari-Notch® cavity for extra noise suppression.

6.625" quarterwave VHF, with built-in low-noise preamplifier for maximum Rx performance.





800 MHz T-Pass trunking multicoupler system, with 421-Series tower-mounted amplifier and high-performance receiver multicoupler system.



(U.S. PAT. 4,249,147, CAN PAT. 1,133,598)

For more information on T-Pass multicoupler systems, see our Seminar Subjects booklet, "T-Pass Expandable Multicouplers: Principles and Applications" (Lit. No. C2001F93). Also see T-Pass system brochures (Lit. No. C1011C94, C1021G93, C1031G93, C1041G93, C1051G93). Tech-Aids No. 92002 (Lit. No. D3001D93) and 93002 (Lit. No. D3011F93). Call us for expert assistance in solving your system design problems.

SIGNAL BOOSTER SYSTEMS • RF SYSTEM PRODUCTS • DUPLEXERS • FILTERS

TX RX SYSTEMS INC. - 8625 Industrial Parkway, Angola, New York - Phone: (716) 549-4700 - Fax: (716) 549-4772

SMR WON attempts to achieve industry concensus on proposed 800MHz wide-area rules

While in Washington, DC, attending the AMTA leadership conference, a special committee of the SMR WON board of directors met with industry leaders to discuss the FCC's proposed 800MHz wide-area rules. Each meeting was arranged by SMR WON, but there was no common meeting with all parties in attendance. The meetings included Nextel and OneComm; Motorola; the FCC's Commercial Wireless Bureau; PCIA; AMTA; ITA; and several Congressional offices. The intent was to establish a basis for negotiations for an industry consensus on rules governing wide-area licensing. The only common ground was on the geographic boundaries for wide-area licensing. The 172 basic economic areas (BEAs), as defined by the Department of Commerce, seemed acceptable by all sides.

Although the FCC has stated that it intends to use auctions for issuing 800MHz licenses, and auctions were discussed as a last resort to market settlements, SMR WON's position has not weakened. The association stands firms in its belief that Congress did not authorize the FCC to auction occupied spectrum.

The SMR WON membership has been asked to continue their lobbying efforts with the same fervor that led to the strong letter from Congress to FCC chairman Reed Hundt. The letter was endorsed by eight members of the House of Representatives and questioned the FCC's proposed use of auctions for overlay licensing of occupied and licensed spectrum.

Midland International completes sale of consumer products division

Midland International, Kansas City, MO, has sold the inventory, fixed assets and other intangible assets of the consumer radio division to Midland Consumer Radio (MCR). Midland has also sold a license for the use of the Midland name and trademark in connection with the sale of citizens band and marine radios and other types of electronic equipment for the consumer market. The transaction does not involve any of Midland's professional or land mobile radio products.

MCR has hired John Chass, formerly of Midland, as the senior vice president of the new company, along with several other Midland employees who are familiar with the Midland consumer products. MCR has leased space at the present offices in Kansas City.

Maxon creates paging division

Maxon America, Kansas City, MO, has created a division devoted to pagers and paging systems. The division has three departments, with each department handling specific aspects of the paging business: general issues; order entry and expediting, product information, pricing and availability; service and technical issues.

"The goal of forming this division was to ensure that Maxon paging products are the best on the market and that they are priced to deliver the same great value as other Maxon products," said Greg Foss, general manager of the new division. "We now have a team of professionals completely focused on the needs of a growing and extremely competitive market."

Brookline to participate in 220MHz SMR market

Brookline Minerals, Vancouver, British Columbia, Canada, intends to wind up its mineral exploration business to focus on the investment and financing opportunities in developing the 200MHz specialized mobile radio (SMR) market in the United States.

Brookline has signed a letter of intent to acquire Brook SIG (BSIG) in exchange for 15 million common shares of Brookline. The Brookline common shares are to be issued to the shareholders of BSIG in three equal parts with 5 million shares issued for each 50 220MHz systems that are successfully financed and constructed in the United States. As part of the transaction, Brookline has agreed to pay a finder's fee of 400,000 common shares to an individual.

Intek Diversified, Los Angeles, Simmonds Communications (SCL), Toronto, Ontario, Canada, and one individual investor each own a one-third interest in BSIG. Through BSIG, Intek and SCL will each enter into an agreement to provide certain management services and technical expertise for the development of Brookline's ongoing business strategy. As payment, Intek and SCL will each receive one million common shares of Brookline. Upon completion of the transactions, Brookline will change its name to Brookline Capital.

Avtec decides not to renew EDACS license

Avtec, Gilbert, SC, has elected not to renew its license agreement with Ericsson, Lynchburg, VA, covering console interconnection with the Enhanced Digital Access Communications Systems (EDACS) trunking systems. Avtec cited excessive license fees, royalties and support fees compared to the original license agreement negotiated with Ericsson GE Mobile Communications. An agreement was reached between the two companies for the continued support of licensed products for end users.

Law firm, engineering company form PCS migration team

Lockard & White, a Houston-based professional telecommunications engineering company, and Keller and Heckman, a Washington, DC-based law firm, are teaming up to offer technical and legal counsel for incumbents who must meet the challenge of dealing with the PCS revolution.

"Incumbents need to be prepared to address the technical isues associated with the 2GHz band with the PCS provider, and they need to have properly documented costs and plans for migrating out of the 2GHz band use in their discussions with PCS providers," said Marc Lockard, president of Lockard & White.

Uniden appoints Hutton as national distributor

Hutton Communications, Dallas, is adding the Uniden line of UHF and VHF conventional radios to the lineup of products they already offer at their four stocking locations throughout the United States. The company has warehouses in Texas, Georgia, Colorado, Washington and Canada.

E.F. Johnson receives E-Award for excellence in exporting

Governor Arne Carlson of Minnesota presented a certificate of commendation to E.F. Johnson, Burnsville, MN, to recognize the company's efforts in earning the president's "E" Award for excellence in exporting. The company earned its "E" award through a significant increase in exports and expansion of its international business over the past four years.

This is the second "E" Award that E.F. Johnson has received from the federal government. During World War II, E.F. Johnson won the Army-Navy "E" for excellence in wartime manufacturing production. President Kennedy revived the "E" Award in 1961 for export expansion. E.F. Johnson is one of the few companies to receive both awards.

Paging industry adds 7.5 million pagers during 1994

The paging industry added 7.5 million pagers in 1994 for a growth rate of 38%, according to Malarkey-Taylor Associates/Economic and Management Consultants International (EMCI), Washington, DC, in *The State of the U.S. Paging Industry: 1995*, the company's 7th annual paging study. Total paging subscribers grew from 19.8 million at the end of 1993 to 27.3 million for year-end 1994. EMCI projects that the paging industry will continue to grow because of rapid acceptance by the consumer market and implementation of narrowband PCS advanced messaging services such as two-way and digital voice services.

Falling prices for equipment and service are playing a key role in paging's increasing popularity among business and consumer segments. EMCI's report indicates that revenues per pager are still declining, but at a lesser rate than in previous years.

EMCI projects that pager revenues will stabilize in the next several years because of further consolidation within the industry and the introduction of technological advances such as two-way and acknowledgment paging, advanced data applications and digital voice pagers.

During 1994, digital display pagers accounted for about 87% of all pagers in service. Tone-and-voice pagers accounted for 3% of pagers in service, and tone-only pagers accounted for 2%. Alphanumeric pagers remained stable at 7% in 1994 but are projected to increase to 9% of all pagers in service this year.

Simmonds, Securicor to explore joint ventures

Simmonds Communications, Toronto, Ontario, Canada, and Securicor Communications, Surrey, United Kingdom, have entered into discussions to explore joint development opportunities in the telecommunications and wireless communications markets. At this point the discussions are exploratory, but the two companies will begin working together to develop a potential business plan.

Four cities select Trimble GPS/AVL systems

Public safety fleets in Cincinnati, San Francisco, Irvine, CA, and Fresno, CA, have selected Trimble's GPS-based automatic vehicle location (AVL) products. The systems are used to locate, manage and dispatch public safety vehicles for enhanced operations and increased response time.

PCS '95

PERSONAL COMMUNICATIONS SHOWCASE

Committed to the Wireless Vision

BECAUSE FRONTIERS DON'T STAND STILL

Seize the opportunities opened by "anytime, anywhere" communications. Get all the facts. Attend PCS '95 — the one event that covers the whole spectrum of wireless communications.

September 21-23, 1995
Orange County Convention Center
Orlando, Florida

PCS '95 has 200+ exhibits and more than 30 conference sessions to put you in touch with everything that matters in personal communications:

Cellular Phones • Imaging • Infrastructure • Mobile Data • Mobile Satellite Technology • Pagers • PCS • Personal Digital Communicators • Portable Computing • Smart Cards • Software • Video Mail • Voice Mail • Wireless LANs • Wireless PBXs

In the new communications frontier, to lead is to succeed. Take your place among PCS industry leaders, register for PCS '95 today.

For more information, please call PCS '95 at:
TEL 1.800.416.5521
FAX 1.617.329.8090
WEB ADDRESS http://www/exporeg.com/pcia

Sponsored by the Personal Communications Industry Association

Circle (63) on Fast Fact Card

News

Illinois county purchases Motorola 800MHz trunked system

The Cook County, IL, department of corrections (DOC) has purchased a Motorola, Schaumburg, IL, 800MHz trunked SmartNet radio communications system to be used by divisional and unit personnel.

The six-channel system is part of a five-year DOC communications master plan. The portable units are equipped with SecureNet digital voice encryption and feature unit identification, an emergency call button that allows DOC personnel to alert telecommunicators without voice transmission, group call capabilities and the flexibility to accommodate a variety of other communications features the department may choose to add in the future.

Black Hawk, IA, chooses carrier employing Ericsson technology

Public safety officials in Black Hawk County, IA, selected Racom, Marshalltown, IA, for their dispatch communications. Racom is a commercial enhanced specialized mobile radio (ESMR) operator that uses digital technology from Ericsson, Lynchburg, VA.

With the Enhanced Digital Access Communications System (EDACS), each agency sharing the network will be able to maintain its individual needs while allowing communications between separate user groups in situations when more than one agency needs to respond to an emergency call.

Uniden forms Wireless Data Products Division

Uniden, Ft. Worth, TX, has formed a new Wireless Data Products Division to be based in its Dallas/Ft. Worth headquarters. Tim Moore, vice president of sales and Greg Jones, vice president of product & technology, both of the Commerical Communications Division, have been promoted to head the new division.

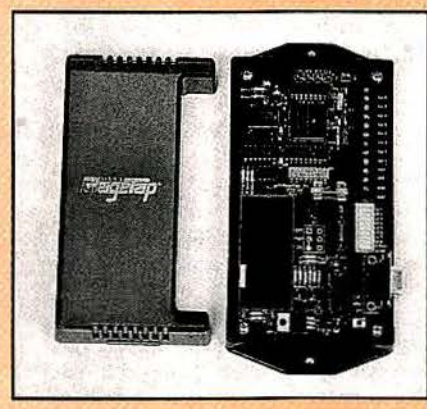
Readers' choice

Of all the new products and services in the **February 1995** issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Switch uses digital paging systems to transmit remote control signals

The PT8-OC remote control switch from **PageTap** uses existing digital radio paging systems to receive remote control signals. Signal audio is decoded by the unit and transferred to eight open collector outputs. Each output can be individually programmed to latch until signaled again, or set to time delay from 1/8 of a second to 24 hours, thereby combining latched outputs and time delays.

Circle (500) on Fast Fact Card



Durable hand-held for 800MHz features dual-display capability

The Avenger SI 800MHz hand-held from **E.F. Johnson** is a 3W radio available in three-button and DTMF models. It can be programmed for as many as 14 systems with 10 groups per system. Standard features include system and group scan, talk-around, menu-driven operation, and a seven-character alphanumeric LCD with dual display capability. Also included are a programmable option button, a 16-position quick-select knob, phone mode operation and a sealed accessory connector. The unit meets MIL STD 810 specifications for durability and environmental conditions.

Circle (451) on Fast Fact Card

New products

Lightweight service monitor offers portability for benchtop and field use

Weighing less than 25 pounds, the 2945 Testmate communications service monitor from **Marconi Instruments** is designed for both field and bench use. Standard features include a full-span spectrum analyzer with a "live" look-and-listen feature, a tracking generator with offset tracking, two variable audio generators, 150W RF power measurement and 5W protection on all ports. Other features include an LCD with rapid refresh rate for easy monitoring and adjustment, an RS-232 control interface for PC automated testing, a PCMCIA II memory card for storing settings and test results and a 50kHz digital storage oscilloscope with anti-aliasing.

Circle (452) on Fast Fact Card

Alert receiver offers 2W audio output, field-programmable alert tones

The model 2TR9 Tone Alert Receiver from **Reach Electronics** features field-programmable\ RF (low, high and UHF) and tone codes. Other standard features include remote switch output, DIP switch-programmable codes, monitor capability and over 2W of audio output. The unit's capabilities include group call, selectable timeout and internal alert. Battery backup and solid-state voice storage are available as options.

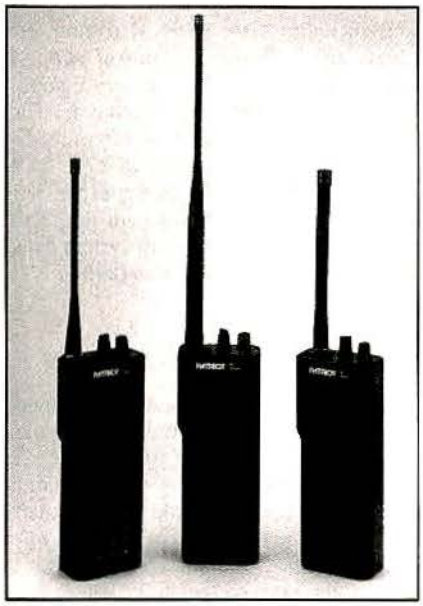
Circle (453) on Fast Fact Card

NPSPAC-compliant portables, mobiles, expand 800MHz line

Kenwood Communications is making available public safety NPSPAC-compatible models of its existing 800MHz and portable radio products. The TK-930HDK2 35W mobile and the TK-430K4A 2.5W portable are both FCC type-accepted for NPSPAC operation. Key design considerations for NPSPAC compatibility include maximum ±4kHz deviation, higher-stability oscillators and narrower receiver IF filters. The field-programmable TK-430K4A portable can use any one of 16 systems with 10 groups each. The TK-930HDK2 trunked mobile provides 10 systems with 10 groups per system, system scan and group scan capability, and QT, DQT and talkaround in the conventional mode.

Circle (454) on Fast Fact Card

Redesigned portable series offers signaling format enhancements

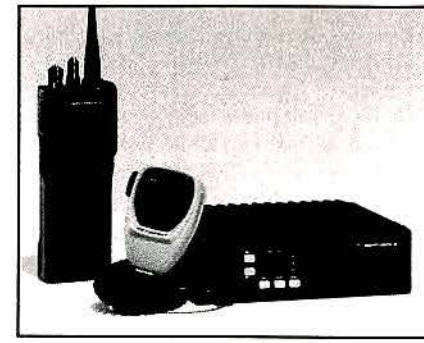


Ritron has redesigned its Patriot RTX portable radios (UHF, VHF and lowband) to produce richer tonal quality, higher clarity and wider volume range. Already equipped with CTCSS, DCS and two-tone, the radios have new signaling enhancements including 12 new CTCSS tones (51 total), one custom CTCSS tone and an expanded two-tone decode range. User control of an RTX portable is increased while in paging or scan mode. This control includes priority/last active TX, paging/tone/carrier select and last active channel indication.

Circle (455) on Fast Fact Card

New products

Mobile, portable line incorporates non-proprietary LTR protocol



The MaxTrac-LS mobile and the MTX-LS portable are the first radios developed by the Land Mobile Products Sector of **Motorola** to operate on non-proprietary logic trunked radio (LTR) protocol SMR systems.

The mobile unit, available in 15W and 35W versions, is equipped with a two-digit display and front-mounted controls. The mobile is equipped for 10 systems, 10 talk groups and 10 conventional channels. Other standard features include talkaround, scan and selective call. Signaling schemes include MDC 1200, Star, Quik Call II, Singletone and DTMF.

The 3W portable unit has a 15 systems/three talk group systems capacity and offers as many as 15 conventional channels with talkaround and scan as well as conventional signaling. As part of the MTX 8000 series of portables, the MTX-LS can use that line's full range of accessories, including chargers, microphones, antennas, carrying cases and belt clips, surveillance equipment, batteries and headsets.

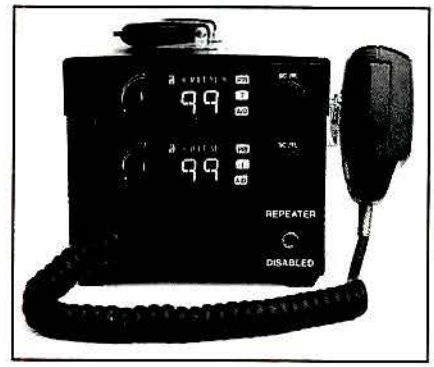
Circle (456) on Fast Fact Card

Power supply integrates features for metering, backup, disconnect

The **Newmar** Integrated Power System combines the functions of power supply, battery backup, load disconnect, alarm contacts and system monitoring in one package. The unit is designed for applications including base stations, paging terminals and cell sites. A power supply/battery charger and all accessory components are contained in a 19" chassis. The prewired system, calibrated for immediate installation, is available in 12V, 24V or 48V models with 475W or 875W ratings. A service manual tray on the front panel provides easy access to system data.

Circle (457) on Fast Fact Card

Crossband, in-band repeaters allow custom combination of radios



Two mobile repeaters, one crossband and one in-band, from **Relm Communications** allow users to combine Relm SL and SM series radios for their specific needs. The new repeaters are targeted at rescue, EMT and surveillance applications. Both the RCBR (crossband) and RIBR (in-band) repeaters operate from any 12Vdc source and are capable of serving 6, 16 or 99 channels. The units have 40W VHF and 25W UHF transmitter power, a hand mic and a built-in speaker. The RCBR includes a cooling fan, dual speakers and local control. VHF and UHF duplexers are also available for the RIBR. An optional DTMF mic is available for both systems.

Circle (458) on Fast Fact Card

Digital audio recorder includes time logging, memory expansion

Addcom Communications' SMDVR digital audio recorder offers one hour of message storage capability from a device about the size of a portable calculator. Standard features include simultaneous record and playback, message save, pause, date/time stamp and index counter. An optional PCMCIA memory card slot allows memory expansion for as long as 15 hours of continuous recording.

Circle (459) on Fast Fact Card

Release of 30m files increases grid density for topographical database

SoftWright has released 30-meter topographical database files for engineering modeling of radio and link system performance. The new files provide an increase in grid density of about nine times the data within a given area. This increases the number of grid points within a 7.5" quadrangle from 22,000 in a 3" file to about 202,000 grid points with the 30-meter grid interval. The increase in grid density increases the accuracy of elevation data information in SoftWright's Terrain Analysis Package (TAP) radio engineering software. About half of the continental United States, all of Hawaii and selected parts of Alaska are available in the high-resolution digital elevation model. The U.S. Geological Survey is making available about 200 new digitized 7.5" quadrangles each month.

Circle (460) on Fast Fact Card

Frequency-synthesized FM portable for UHF uses wideband frequencies

The 70-248 portable from **Midland International** is a frequency-synthesized UHF band FM radio that operates in a wideband frequency range of 406MHz–470MHz and features user-selectable 4W or 2W of RF output power. The unit offers as many as 99 channels, of which 48 may be programmed for semi-duplex operation. The 70-248 has pushbutton up-down channel selectors, an MX-type antenna connector, a rotary on-off/volume switch and internal preset squelch. Scanning may be accomplished by either a programmed scan list or triple watch, with two user-selectable priority channels and a home channel. All 83 DCS codes and 37 CTCSS tones are programmable at random by channel.

Circle (461) on Fast Fact Card

Free service manual describes use of pager hot air rework-and-repair

Automated Production Equipment has created a free instruction manual for facilities servicing Motorola Bravo Express and Encore pagers. The step-by-step instruction describes removal and replacement of QFD surface-mounted compents using A.P.E.'s Chipmaster BGA/SMD hot air rework-and-repair station. The manual includes illustrations, instructional text and a descriptive list of necessary tools and materials. The Chipmaster features closed-loop, microprocessor-based control, temperature profiling capabilities and controlled temperature ramp features.

Circle (462) on Fast Fact Card

Software helps managers of wireless radio communication facilities

ComSiteManager for Windows, from **Douglas Integrated Software**, is a database manager applicable to either one communications site or an entire network. The software allows site managers to track information such as communications shelter electrical, standby power and HVAC loads. It also manages equipment inventory, maintenance records, antenna locations and tower space availability. Managers also can track operating frequencies and circuit numbers, FCC and FAA license data and tenant leasing and billing information. ComSiteManager also provides a task scheduler with reminder alarms to prevent missed dates for important action such as preventive maintenance schedules.

Circle (463) on Fast Fact Card

Low-ambient, vertical-mount air systems economize shelter cooling

The Marvair ComPac I and ComPac II air conditioners from **Crispaire** are vertical wall-mount models with front control box panels. Designed primarily to cool electronic and communications equipment shelters, the two models have the necessary controls and components to continue removing a high internal heat load even when the ambient external temperature falls below 60°F. The ComPac II has a factory-installed economizer that senses outside air, and if cool and dry, uses that air to cool the shelter. The economizer provides temperature control, energy cost savings and increased reliability by decreasing the operating hours of the compressor. Other features include remote alarm capability and sloped-top flashing that eliminates the need for a rain hood.

Circle (464) on Fast Fact Card

New products

Radio-linked collection system provides inventory acquisition, tracking

The Data Integrator/W is a radio-linked bar code data collection applications system developed by **Monicor Electronic**, CIM Concepts, Compsee and Mars Electronics International. The system provides inventory and tracking acquisition for manufacturing, warehousing and distribution. Built-in interfaces are compatible with a variety of protocols, and data collection applications can be directly integrated with existing mainframe or newer client-server applications. Real-time automation is available using Monicor compact radio modems, Mars MEQ scanners and a desktop computer. The system supports both Windows 3.1 and Windows NT.

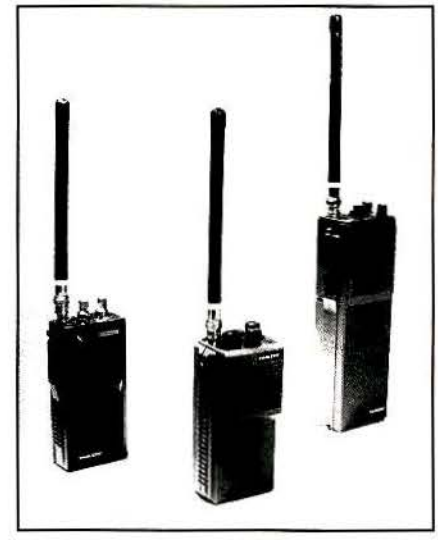
Circle (465) on Fast Fact Card

Paging concentrator now blocks unauthorized group call access

Hark Systems has added a feature to its TAP-200 alphanumeric concentrator to block prolonged paging groups. The concentrator now limits the number of pages delivered into the paging system on a per-call basis. This feature prevents unauthorized group calls from gaining access to the paging terminal. All new TAP-200 units are being manufactured with this feature. Updated proms are available to retrofit existing TAP-200 units on site.

Circle (466) on Fast Fact Card

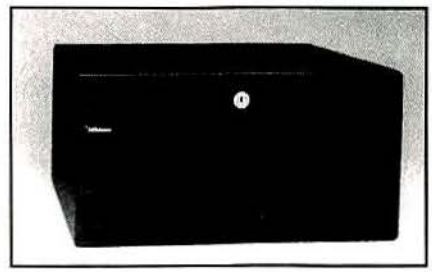
Transceiver set provides selection of bands, channel configuration



Three EasyTalk transceivers from **Nady Systems** include rechargeable NiCd batteries, ac/dc charger, rubber duck antenna with BNC connector, protective vinyl case and stainless steel belt clips. The VHF-30 is a 5W, four-channel transceiver with a five-mile range. The crystal-controlled model can be modified with three additional channels. The VHF-40 offers the same power and range along with six-channel capability. The UHF-50 has one standard channel installed and can be modified with as many as three extra channels.

Circle (467) on Fast Fact Card

Repeater brings high-speed data, external signaling to 900MHz



E.F. Johnson has added a 900MHz model to its Viking VX line of LTR trunking systems. The repeater features 75W of RF output power and has a high-speed data bus, an external signaling interface, a companding option and battery backup. The VX repeaters are fully synthesized with remote diagnostics and alarms, RF amplifier protection and PC programming capability.

Circle (468) on Fast Fact Card

Fiberglass communications shelter features triple-seal wall joints

The Ultra communications shelter from **Fibrebond** is a "caulkless" building with fiberglass structural members. The shelter features triple-seal wall joints, no primary caulk joints, noncombustible interior finishes, rustproof stainless-steel exterior fasteners and hardware, and UL-approved fiberglass doors, jambs and thresholds. Available with a choice of exterior and interior finishes, the building has a warranted roofing system and is manufactured in compliance with 1994 UBC, 1993 NEC, BOCA, SBC and U.S. DOE codes.

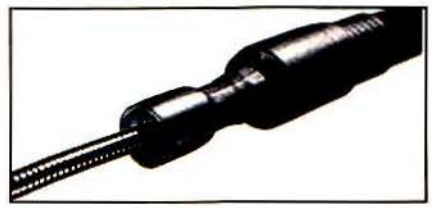
Circle (469) on Fast Fact Card

Isolation chamber has absorbing liner to simulate free-space testing

The Micro RF Isolator, from the Communication Test Equipment Division of **Motorola**, is a portable screen room that provides isolation from RF interference during testing. The isolator's absorbing liner limits reflection and simulates free space, even though the unit under test is in a closed chamber. This allows testing of both transmission and reception devices. A joystick manipulator, incandescent lighting and a viewing portal allow the operator to see and access most of the control buttons on the device under test.

Circle (470) on Fast Fact Card

Weatherproofing kit protects 7/16 connections without heat or tape



Andrew and 3M have developed a 7/16 DIN version of the Cold Shrink weatherproofing kit. The kit is designed to weatherproof jumper assemblies at the antenna and from the main feeder to the radio in as little time as three minutes. The weatherproofing wrap applies a continuous compression that prevents moisture from migrating into a coaxial cable system through a connector interface. No heating, tool or tape is required.

Circle (471) on Fast Fact Card

PC-based mobile data provides real-time response for public safety

The PacketCluster mobile data communications system for public safety applications uses packet radio for real-time messaging and data communications among fixed and mobile users. The system, from **PacketCluster Systems**, runs on either a 386- or a 486-based personal computer. The law enforcement version includes a special "traffic stop" key to quickly determine whether a stopped vehicle is stolen or whether there are warrants on the owner. Interfaces to CAD and records management systems give immediate access to name and address history and incident reports. An optional AVL module is available.

Circle (472) on Fast Fact Card

New products

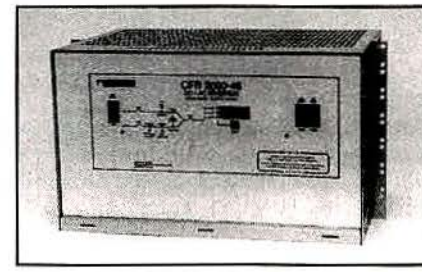
Communications system analyzer incorporates TDMA testing capability

The Communication Test Equipment Division of **Motorola** has developed the R-2660 communications system analyzer with fully compatible Integrated Dispatch Enhanced Network (iDEN) TDMA radio-testing capability. The tester incorporates all the power and design ergonomics of the Motorola R-2600 test set with additional iDEN-specific capabilities. Users can verify call processing for dynamic radio testing through system simulation. The unit can test iDEN digital systems under actual TDMA conditions and includes a bit-error test for quantitative measurement testing.

Circle (473) on Fast Fact Card

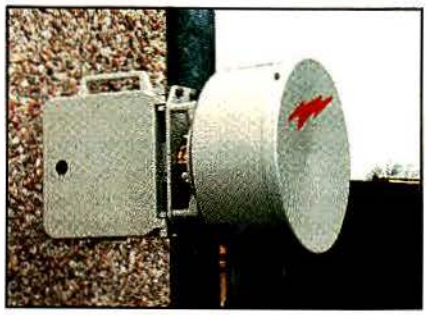
Inverter for telecommunications provides 120Vac continuous power

The CFR 2000 inverter from **Pylon Electronics** provides primary, "no break," 60Hz, 120Vac output for applications where continuity of ac power is critical. The 2KVA continuous-duty telecommunications inverter operates from a 48Vdc nominal source. The convection-cooled unit features an isolated, regulated and short-circuit-protected output. As many as four CFR 2000 units may be paralleled to provide an 8KVA power plant.



Circle (474) on Fast Fact Card

Microwave antenna system serves short-haul PCS, cellular needs



The ValuLine series of microwave antennas from **Andrew** is designed for short-haul applications in the 10GHz–57GHz frequency bands. Applications include cellular, PCS/PCN, private microwave network and intercity relay systems. Available in both shielded and unshielded versions, the antennas range in size from 1 foot to 6 feet. The antennas feature full-range azimuth and elevation adjustment. The antenna feed system is watertight, and pressurizable. Both IEC and EIA output flange types are available.

Circle (475) on Fast Fact Card

Headset applies active reduction to low-frequency noise environment

The ProActive 1500 headset system from **Noise Cancellation Technologies** reduces low-frequency noise in the 30Hz–1,200Hz range by as much as 15dB. The lightweight, open-back headset is designed for two-way radio applications where engines, motors or fans add low-frequency noise to the environment. Twelve hours of operating power is supplied by a small, rechargeable NiCd battery that snaps into a lightweight belt pack. For high-noise environments with a wide frequency range, NCT offers the ProActive 3500, which combines active noise reduction for low frequencies with a passive earmuff for the middle and high frequencies.

Circle (476) on Fast Fact Card

New products

Narrowband PCS pager delivers voice messaging

The Tenor voice pager from the Advanced Messaging Systems Division of **Motorola** uses the company's proprietary Inflexion digitally compressed voice protocol for efficient use of spectrum and greater channel capacity. Tenor allows users to receive stored voice messages anytime, anywhere, from a belt-worn, portable answering machine. The voice unit initially will be available through **PageNet's** VoiceNow service. Features include variable message length, as much as four minutes of message storage, and multiple volume settings. Tenor operates on 900MHz narrowband PCS spectrum. (See related story on page 42.)

Circle (477) on Fast Fact Card

Shelter manufacturer adds installation services

Miller Telecom Services, a full-service shelter manufacturer and telecommunications expansion company, has added services for equipment installation. The company provides a dedicated structure to accommodate the warehousing of radio frames and associated materials. A team of technicians installs and tests many different types of equipment including Northern Telecom, Ericsson, Motorola and AT&T. Miller Telecom also supplies and installs several types of power equipment, including C&D, GNB, Lorain, Peco II and Argus.

Circle (478) on Fast Fact Card

Literature

Tutorial discusses timing, synchronization

A 39-page Digital Network Timing and Synchronization booklet covers synchronization sources available to provide timing reference for digital network connectivity. This second edition takes into account recent standards and new technology such as Sonet. The tutorial is divided into 13 chapters, covering such topics as history of timing in the switched network; a network slip, what happens?; typical clock systems; stratum levels defined.; the stratum hierarchy; and designing a network.

Circle (250) on Fast Fact Card

SourceBook expands to cover ESMR, PCS industries

The 1995 **CTIA** *Wireless SourceBook* consists of the Wireless MarketBook, the Wireless MemberBook and the Wireless FactBook. Each provides information about the cellular, enhanced specialized mobile radio (ESMR), mobile satellite services and the Personal Communications Services (PCS) industries. The FactBook includes explanations of wireless technologies with statistical information about each; listings of the top 30 wireless operators; the top 25 cellular carriers; and the top 20 international markets.

Circle (251) on Fast Fact Card

Directory lists frequencies by several categories

A 420-page aeronautical frequency directory from **Official Scanner Guide** covers HF, VHF, UHF 225MHz–400MHz military, 450MHz–470MHz and 800MHz–900MHz. The community format lists frequencies by state, city airport, service, license, airport code, call sign, frequencies and comments. Included in this section are civilian and military airports with VHF and UHF frequencies. Airport designators have been expanded. FAA coverage includes separate center listings with both VHF and UHF frequencies, flight service stations and enroute flight advisory service.

Circle (252) on Fast Fact Card

Catalog contains more than 1,000 new items

The latest catalog from **MCM Electronics** contains more than 1,000 new items, including project accessories, semiconductors, connectors, test equipment, computer products, audio, TV, VCR and appliance-repair parts. This catalog also introduces Motorola two-way radios, SL Waber power distribution products, caller identification devices from TT Systems and Sherwood car head units and amplifiers.

Circle (253) on Fast Fact Card

Catalog describes coaxial connectors

A 160-page catalog details the Spinner GmbH coaxial connector group available nationally through **Precision Tube.** The Spinner connector assortment ranges in size from 3.5mm to 16mm in diameter (of the outer conductor) and includes 1–16 connectors for cellular and mobile communications systems, with low IM performance. The catalog includes complete specifications, ratings, mating sizes, engineering drawings and application data to help with product selection.

Circle (254) on Fast Fact Card

Catalog covers tools, test equipment

Jensen Tools' spring 1995 Catalog Supplement D presents 72 pages of service products for data and telecom equipment and systems. Included are test equipment, tool kits, wire and cable, connectors and connector kits, PC diagnostics, soldering equipment, benches and bench accessories and cleaning supplies.

Circle (255) on Fast Fact Card

People

Goryance

Wilson

Baugh

Brown

Changes at Allen Telecom Group (ATG), Cleveland:

F. Kim Goryance, marketing director for ATG, advances to president of the company's A/S Mobile Division. Goryance replaces **Pedro G. del Cuadro,** who has left the company.

Reed Wilson leaves Ericsson, Lynchburg, VA, as manager of business development for Strategic Alliance Partners to join ATG as director of systems engineering for the Systems Division.

Elaine Baugh exits Argus Business, Denver, as vice president and group publisher, and forms E Comm International, a marketing, advertising and public relations company in Tucson, AZ.

Cordell Brown departs Pittencrief Communication, Albuquerque, NM, as corporate direct account executive to join Kenwood Systems Group, Houston, as sales manager.

Changes at Mtel, Jackson, MS:

M. Bernard Puckett, president, adds the title of chief executive officer.

Jai P. Bhagat, chief executive officer of Mtel's Destineer unit, also becomes president and chief executive officer of the company's subsidiary, SkyTel. In addition, he was elected as a vice chairman of Mtel.

John E. Welsh III was elected as a vice chairman of Mtel.

Ross W. Holman leaves Sprint, Reston, VA, as assistant vice president, business systems development to join PageNet, Plano, TX, as vice president of information systems.

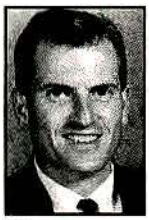
E. Kirk Ellis exits Lawrence Behr Associates, Greenville, SC, as director of project integration, to join BellSouth PCI, Raleigh, NC, as a network engineer.

Frank Carroll, international sales manager for Loral Microwave-Narda, Hauppauge, NY, advances to director of international sales.

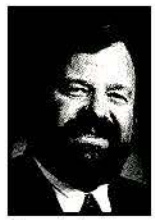
Grant Davis leaves Motorola, Schaumburg, IL, as international training manager to join Ericsson Private Radio Systems, Lynchburg, VA, as global sales training manager.

Robert Cissell leaves the United States Chamber of Commerce, Washington, DC, to join JBro Batteries, Lisle, IL, as sales consultant for the Southwest region.

William F. Hart exits the National Aeronautics and Space Administration as director of the television service to join the Personal Communications Industry Association, Washington, DC, as director of public affairs.


Gilroy


Culver


Fountaine

Changes at Centurion International, Lincoln, NE:

Todd Gilroy leaves Chicago-based Grant Thornton LLP's Lincoln office as an audit supervisor to join Centurion as comptroller.

Duane Culver, quality manager, advances to plant manager for the battery division.

Nigel P. Fountaine departs Magnavox, Torrance, CA, as sales manager, to join Mobile Satellite Products, Hauppauge, NY, as sales manager.

Donna Irby, customer service manager for Hutton Communications, Dallas, advances to product manager.

John J. Sullivan, director of sales and marketing for Selectone, Hayward, CA, advances to vice president of sales.

Changes at Broadcast Communications, New Glarus, WI:

Merlin J. Anderson leaves the Private Data Systems divison of Motorola, Schaumburg, IL, to manage Broadcast Communications' Intertech Solutions division.

Glenn A. Kramer, purchasing manager, advances to manager of Education Services, a new division of Broadcast Communications.

Gladney Flatt departs SpreadNet, Dallas, as manager of marketing communications to join Pinpoint Communications, Dallas, as manager of marketing communications.

Keith Gibson leaves Comverse Technology as regional managing director to join Coherent Communications Systems Corp. (CCSC), Leesburg, VA, as managing director of its UK division, Coherent Communications Systems Ltd., operating from Abingdon, Oxfordshire, United Kingdom. Gibson takes over for **David Powell,** who advances to president of CCSC.

Changes at Transcrypt International, Lincoln, NE:

Jeffrey L. Fuller leaves E.F. Johnson, Burnsville, MN, as vice president of North American sales to join Transcrypt as president.

Tom Stanton leaves E.F. Johnson as senior director of marketing to become vice president of engineering and marketing at Transcrypt.

Tom Tambling, major accounts manager; **Ron Kabler,** vice president of engineering; and **Alan Stewart,** general manager of strategic business unit sales, leave the company.

Hal Wooden departs Northern Technologies, Liberty Lake, WA, as director of PCS Business Development to join Power Conversion Products, Crystal Lake, IL, as Southwestern regional sales manager and director of PCS sales.

Letters from readers

Lightning protection:

I am writing in response to the article, "Lightning Protection Theory: More Fuel for the Debate," by Bruce Kaiser, from the April 1995 issue. In the interest of public safety, I feel compelled to respond to several points that may not have been clear.

It is my understanding that the independent scientific community does not find much to debate when it comes to "streamer-retarding," "streamer delaying," "streamer emitting" or whatever the latest name may be that lightning protection gadgets are sporting. Contrary to Mr. Kaiser's statement that grounding and bonding are less significant portions of a lightning protection system, scientists stress that effective lightning protection involves much more than air terminals. Good grounding, bonding and surge suppression are equally important components in an effective lightning protection system.

In this advanced age of electronics and computers, lightning-induced damage poses more of a threat than ever. Modern technology has succeeded in providing lightning protection for the sophisticated electronics and composite skin of the Stealth bomber and for nuclear missile silos. This same technology can certainly be used to effectively protect radio transmitting and receiving equipment.

Several years ago, the Federal Aviation Administration (FAA) looked into the type of lightning protection that Mr. Kaiser's article describes. The report on the investigation speaks for itself. It is my understanding that, following its experiments, the FAA removed the unconventional lightning protection equipment and installed standard lightning protection systems.

Mr. Kaiser's article references the work of National Fire Protection Association (NFPA) Committee 781. I find it odd that Mr. Kaiser, as a voting member of the Committee 781, fails to explain in his article that in the Fall of 1993, the general membership of the NFPA voted overwhelmingly against the publication of the document that Committee 781 had drafted. Following that vote, the NFPA Standards Council issued a decision not to publish a standard for early streamer emission-type lightning protection because there exists "genuine and legitimate questions on whether the early streamer emission technology has been adequately demonstrated to be effective." It should also be noted that there has been no activity within Committee 781 for the last year and a half.

Mr. Kaiser's article implies that the National Aeronautics and Space Administration (NASA) uses exotic forms of lightning protection in certain applications. From speaking with representatives of NASA, I have gathered that the agency has experimented with various types of lightning protection. I am not, however, aware of NASA actually opting to rely on anything but nationally accepted lightning protection methods. You may wish to contact NASA to confirm its position on "dissipation arrays" and "streamer-type" lightning protection gadgets.

It is not my intention to become involved in a debate over lightning protection theory. My firm currently manufactures more than 1,000 elements of lightning protection components. We have wire- and cable-making machines, a full-service foundry and numerous other types of metal-working equipment. If we could find a scientific or practical basis for the types of lightning protection that Mr. Kaiser's article describes, it would be simple for us to add these products to our inventory. We have decided not to manufacture or sell unconventional air terminals, because atmospheric scientists have not been able to provide us with justification for their use.

Scientists tell us that at any given location, the ionization that surrounds an air terminal is constant regardless of the number of points or the exotic shape that air terminal may have. The additional points that a brush-like air terminal contains do not in fact significantly affect the total amount of ionization that occurs. Thus, the performance of brush-like air terminals is no different than the performance of traditional air terminals under identical conditions.

In the interest of providing credible information to your readers, I encourage you to solicit the opinions of independent lightning experts. It is their opinions, not the opinions of industry members such as Mr. Kaiser and myself, that your readers need to learn about.

Charles H. Ackerman
President
East Coast Lightning Equipment
Winsted, CT

The results of the FAA's investigation of the type of lightning protection that Mr. Kaiser's article describes are detailed in the FAA document "1989 Lightning Protection Multipoint Discharge Systems Tests — Orlando, Sarasota & Tampa, Florida," also identified as "FAATC T16 Power Systems Program, ACN-210 Final Report 12/31/90."

The report is difficult to obtain from the government. Employees at the FAA's Washington headquarters and at its Atlantic City, NJ, Main Library and National Air System Documentation department confirm that the document is unavailable for public purchase. One copy that has been circulating originally was obtained on behalf of a constituent by a member of Congress. The report was controversial when it was completed, and apparently it remains so.

We've been told by an FAA official that a copy of the document can be obtained by filing a Freedom of Information Act (FOIA) request. Readers who want to obtain a copy from the government might either ask an elected representative or file an FOIA request with the FAA. The document is about 50 pages, including several appendices.

Mr. Ackerman will supply a photocopy of the document for $10. Tel. 203-738-2396. —DB

Mobile Radio Technology™

The journal of mobile communications technology

BUSINESS

Cameron Bishop, *Senior Vice President*
Mercy Contreras, *Publisher*
Darren Sextro, *Associate Publisher*
Kathryn Buckley, *Promotions Manager*
Denise Kettler, *Senior Promotions Coordinator*
Liz Turner, *Senior Advertising Production Coordinator*
Nancy Hupp, *Advertising Production Manager*
Dee Unger, *Director Advertising Services*
Tammy Kalebaugh, *Classified Advertising Coordinator*
Tom Cook, *Group Senior Managing Editor*
Doug Coonrod, *Corporate Art Director*
Kim Bracken, *Art Director, Special Projects*
Stephanie Hanaway, *Group Director of Ancillary Products*

Raymond E. Maloney, *President and CEO*
Nick Cavnar, *Vice President of Circulation*
Barbara Kummer, *Circulation Director*
Michele Bartlett, *Circulation Manager*
Customer Service, *800-441-0294*

ADVERTISING SALES OFFICES:

ENGLEWOOD, COLORADO

Carla M. Gamino, *303-220-4244, East region (including Eastern Canada)*
Mercy Contreras, *Publisher, 303-220-4245*
5660 Greenwood Plaza Blvd., Suite 350
Englewood, CO 80111
Phone: 303-793-0448
Fax: 303-793-0454

OVERLAND PARK, KANSAS

Joyce Bollegar, 913-967-1840, *Midwest region,*
Fax: 913-967-1901
Classifieds, 913-341-1300
Lori Christie, *List Rental Services Representative*, 913-967-1875, Fax: 913-967-1897
9800 Metcalf Ave.
Overland Park, KS 66212-2215

SAN RAFAEL, CALIFORNIA

Dennis Hegg, *West region (including Alaska, Hawaii and Western Canada)*
950 Northgate Drive, Suite 207
San Rafael, CA 94903
Phone: 415-491-1442
Fax: 415-491-1842

OXFORD, ENGLAND

Richard Woolley, *International*
Jane Moseley, *International*
Unit 3, Castle Farm Business Centre, Clifton Road
Deddington, Oxford, OX15 4TP, United Kingdom
Phone: +44 (0)1869 338794
Fax: +44 (0)1869 338040

Professional services

Professional Consulting Services

Category Index

Employment

Classified

Employment

CAREER STALLED?

CALL AAA FOR ASSISTANCE!

If you're feeling stranded in your present position, call CSAA. We might have just the pick-me-up you seek. We're the No. California, Nevada and Utah affiliate of AAA offering roadside assistance, insurance and travel-related services. Right now, we need you to help keep our customers on the road.

Radio Technician

You'll install, modify, test and maintain/repair radio communications equipment in our field offices and contract towing stations. Van & tools provided.

2-way radio communications equipment installation and component-level repair knowledge (esp. Motorola); FCC regulation familiarity; and excellent communications abilities are required. Must also have an acceptable driving record & a valid driver's license.

Send a resume to: Personnel Dept./RTMRT, 150 Van Ness Avenue, San Francisco, CA 94102-5279. Fax (415) 565-4582. We strive to equally employ populations as diverse as the customers we serve.

CALIFORNIA STATE AUTO ASSOCIATION

City of Ontario
Communications Maintenance Coordinator
$4298 - $5247 per month
Plus City Paid PERS

This is a supervisory management position in the Ontario Fire Dept. with responsibility for the maintenance, installation, construction & repair of electronic comm equip & systems for the City of Ontario & the maintenance contract for the West End Communications Authority (WECA) 800 MHz backbone sytem. Equiv. to BA (relevant exp may be sub'd on year to year basis); 5 years progressively resp exp in comm systems installation, maint, repair & testing, including 2 years of supervisory exp is required. A degree in electrical eng & related exp with a state, county, or municipal government is highly desirable. Original City application required. Position open until filled. City of Ontario, Personnel Dept., 303 East "B" St., Ontario, CA 91764, 909-391-2580 AA/EOE/ADA

SYSTEMS TECHNICIANS-ENGINEERS

Tri-State Radio, one of the nations fastest growing paging companies, is currently seeking Systems Technicians and Engineers for our NY-NJ Metro, Philadelphia, Baltimore/Washington and Boston systems. Responsibilities will include maintaining Motorola paging transmitters and/or Glenayre paging terminals. Minimum 1 year CURRENT experience in paging is required. Applicants for transmitter maintenance should have FCC or Naber Certification. Competitive salary with excellent benefit package including a 401(k) plan. Qualified applicants should send fax or resume and salary history to:

Tri-State Radio
Attn: Engineering
717 Market Street
Lemoyne, PA 17043

E/O/E
FAX: 717-761-8734
NO CALLS PLEASE!

CELLULAR TWO-WAY PAGING PERSONNEL SERVICES

Technical & Engineering Positions Available Nationwide
Fees client paid. Send resume to address below.

ALL LEVELS OF POSITIONS FILLED NATIONWIDE
• Technicians • Engineers • Managers • Sales
•Extensive national resource of personnel
Employers: Call 606-491-5410 10 AM to 8 PM

Communication Resources
P.O. Box 141397 • Cincinnati, OH 45250
606-491-5410/FAX 606-491-4340

Manufacturers' reps

HARRISON RADIO/HARRISON CELLULAR
~since 1925~
Manufacturers' Representatives
Wireless Communications Equipment, Cellular Telephones, Pagers, Commercial Radio Communications Equipt., T&M Equipt., components, supplies
Michael Harrison
545 8th Ave., Suite 401, NYC, NY 10118-0069
1-800-353-6295 • 516-763-6295
FAX: 516-823-0805 *Export Inquiries Invited*

D H Marketing Company
Manufacturers Representatives for Wireless Communications Products
A PAUL DENWALT · CARROLL HOLLINGSWORTH COMPANY
6015 Lohmann's Crossing, Suite 101
Lago Vista, TX 78645
Ph: 800-966-3357 **Fax: 512-267-7760**

Paging

PREMIUM PAGER REPAIR.

RMS Communications Group, Inc.
1-800-627-2022
5100 W. Silver Springs Blvd. Suite 700, Ocala, FL 34482

Get your pagers delivered on time, every time — for pager repair beyond compare, call RMS today!

Circle (101) on Fast Fact Card

Paging

Reprints

Paging

Pager Repair

PAGER REPAIR & REFURBISH
We Pay Top $$ For Used Pagers

PageCo International, inc.

DONT LOSE CUSTOMERS - INSIST ON QUALITY PARTS

Full Service - State of the Art Facility
Certified Technicians

PHONE 305-491-9501
FAX 305-491-8834

We use genuine CRYSTRONICS crystals!

Motorola, NEC, Shinwa, GE and Relm

Pager, Portable Sales & Repair

ICM COMMUNICATIONS

Clean, Repair, Tune, Align to Factory Specs

Customer Service & Sales
1-800-725-1426
Fax
1-800-322-9426

P.O. Box 26330, 10 N. Lee, Oklahoma City, OK 73126-0330

PT TECHNICAL SERVICES

- Motorola & NEC Pager Repair
- LCDs - Recrystal - Repair
- Fast turn around
- Factory Parts
- Accurate in-house tracking system

1-800-263-3193

Equipment for sale

WANTED

STX-HT600-P200-MT1000-MTX800
MAXTRAC, SPECTRA, SYNTOR X 9000 & MARATRAC
GENEROUS TRADE-IN ALLOWANCE OR TOP DOLLARS PAID

Radio Express, Inc. 800-545-7748

Equipment for sale

COMMONWEALTH
COMMUNICATIONS INDUSTRIES, LTD.
602 Lickinghole Road/P.O. Box 312
Ashland, Virginia 23005

Specializing in Automated Paging Equipment

EARL T. Van STAVERN
Chairman & Sales Manager

Bus: (804) 798-9128
Sales Calls: 1-800-633-8844
FAX: (804) 798-5114

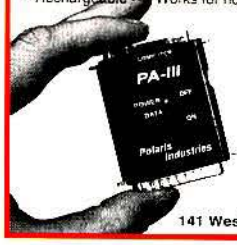
Compatible Motorola® Radio Programming Equipment

PA-I Programming Adaptor...$119.95
- Compatible with "RIB" unit.
- Rugged steel case.
- Power LED.

NOTE: Hardware Only. Software sold by Motorola® and other products are Trademarks of Motorola®, Inc.

FULL LINE OF PROGRAMMING CABLES AVAILABLE
NEW! RADIUS® SP50.....$Call
Package Deal Discounts..15%
GP300/P110, HT50/P100, STX, Gemini, VISAR, JEDI, HT/MT, SABER, SPECTRA®, RADIUS ® MOBILES, MAXTRAC®, and More!

PA-III Pocket Programmer...$169.95
- Micro-Size Design for Convenient Portability and Field Use.
- Uses Surface Mount Technology (SMT).
- Rechargeable — Works for hours on one charge.



PA-II Programming Adaptor...$139.95
- Contains rechargeable NI-CAD Batteries: Perfect for field use and Portable, Laptop & Notebook Computers.
- Status LEDs: Power On and Charge.
- Power Switch.
- Power / Charger Included.
- Runs for 8 continuous hours, from a full charge.

Order Desk:
1-800-752-3571
Polaris Industries

Color Literature Available. Same Day Shipping from Stock!

VISA

141 West Wieuca Road • 300-B • Atlanta GA 30342-3251 • *Tech Info: 404-252-3340* • FAX: 404-252-8929

Circle (107) on Fast Fact Card

Sutter Buttes 2 Way

50	Mitrek 110w LB 42-50 w/acc T81JJA8900CK	$350 ea
2	Motorola Mitrek 110w Base station 42-50	$550 ea
40	Vertex FTL-1011B4 LB 42-50	$395 ea
12	Motorola Maxtrac 60 watt LB 42-50	$425 ea
6	Series 90 DC Remotes S-1902AD	$90 ea
5	Motorola T-1300 Series DC remotes	$60 ea
12	Series 90 Local remotes S-1903CA	$60 ea
1	HT-90 VHF 5w PL (new battery)	$130
2	HT-90 VHF 5w DPL	$100 ea
1	Kenwood TK-230 W/key pad 20f VHF	$295
1	Kenwood TK-330 W/key pad 100f UHF	$395
1	Kenwood TK-730 VHF 32f 45w remote mount	$425
3	GE MPI VHF 2w P5BJJ65BEN	$95 ea
2	Motorola HT-50 UHF 2F W/battery & charger	$295
50	GE Mastr II microphones	$10 ea
50	GE Mastr II control cables	$10 ea
6	GE Deskon II DC remotes	$90 ea
1	Uniden AMU 150K 2F UHF mobile	$95
7	ASP-572 450 transmit antenna (new)	$15 ea
1	Motorola L43TGB6105BM VHFMaxar Base	$100
1	Motorola L35TRK6135 Flexar 800 conv DC	$100
3	Motorola L35TRB6100AM Maxar base 800 conv	$100 ea
3	Motorola MX Rapid charger NLN-8855	$75 ea
2	Motorola Mitrek control cable & head (new)	$75 ea
1	GE Mastr II 100 watt VHF Rptr SC76VAS66C	$1800
1	GE pole mount out door 44" cabinet	$250
2	Motorola 60" cabinet	$100 ea
1	Motorola Micor VHF 100 watt Rptr PL/DPL	$1000

Hundreds of Motorola, GE & Johnson service manuals - call for prices & availability
*WANTED 100 WATT GE MASTR II UHF MOBILES
PH 916-674-7532 • FAX 916-674-1941

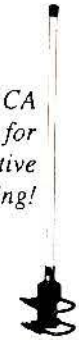
Trust CELWAVE Quality!

- Base Station Antennas
- Bi-Directional Amplifiers
- Duplexers and Combiners
- Filters and Cavities

Call CA Today for Competitive Pricing!

(800) 435-9313
Order Fax (800) 284-4934

CA Communications Associates
A Hutton Communications Company



Circle (108) on Fast Fact Card

Genuine Motorola repair parts. Recently acquired with puchase of Motorola service facility. Over 2800 fine items of new repair parts. Will sell individually or by bulk purchase. Prices are reduced significantly and will sell quickly. Incentive price reductions to bulk buyers.

For more information call, (910) 483-8484 or WRITE to: Professional Communications Inc. Attn: David Callahan, P.O. Box 53650, Fayetteville, NC 28305

Equipment for sale

C. W. WOLFE COMMUNICATIONS

BUY SELL TRADE — All Brands of 2 Way Radios and equipment

1113 Central, Billings, MT 59102 — Call or write for current flyer. — 406-252-9220 Fax: 406-252-9617

LAND MOBILE RADIO BBS

Buy-Sell-Trade used radio equipment with hundreds of other dealers nationwide. Call with your modem to register now.

FCC Database
ONLINE
Low Annual Fee
No Per Minute Charge
The Commline BBS
313-854-6441

USED 2-WAY RADIOS
Call Sid Cohen
at AIR COMM—Phoenix, AX
(602) 275-4505 • Fax (602) 275-4555
30%-70% savings on Motorola, GE, EFJ mobiles, base stations, portables, pagers, repeaters—primarily solid state—all frequency bands. Also, accessory items: Motorola **"Systems 90"** control heads. **PL and paging reeds**, channel elements. Cash quotations made for purchase of above equipment.
AIR COMM
4614 E. McDowell Rd.
Phoenix, AZ 85008

CHANNEL ELEMENTS
YOUR FREQ. - $20.00
with trade-in/3 working days
CRYSTALS $9.95
MAKON, TEKK, UNIDEN/7working days
CEH/Kirby Enterprises
4120 Kirby Rd. Cincinnati, OH 45223
1-800-237-9654
FAX: 513/542-8870

New / Used Reconditioned
2-WAY RADIOS
- Purc's, repeaters, base stations, mobiles & portables
- LB's / VHF / UHF / 800-900 MHz
- Large inventory of late model equipment

Call for quote
We pay the highest prices!
SCOTT COMMUNICATIONS
Ken Scott
406-745-3218

CENTRACOM II
-Buttons and Labels-
$6.50 EACH — Engraved Buttons
All orders shipped within 48 hours.
CENTRACOM II
Reprogramming and
Custom Changes
NORTHEASTERN
COMMUNICATIONS INC.
Waterbury, CT 06708
(203) 575-9008

USED EQUIPMENT
BUY-SELL
- LTR & Motorola
- Conventional & Trunking
- Site Equipment
- Paging Transmitters

STERLING COMMUNICATIONS
Mike Malone
1-800-786-2199
FAX 214-562-7957

Hy-Q
International (USA)
- ☐ **PAGER CRYSTALS**
- ☐ **COMMUNICATION CRYSTALS**
- ☐ **CHANNEL ELEMENTS**
  - **Recrsyalled**
  - **Complete Elements**

48-HOUR SERVICE AVAILABLE
(606) 283-5000
FAX: 1-606-283-0883
1438 Cox Ave., Erlanger, KY 41018
(Greater Cincinnati Area)
"Precision Quality Quartz Crystals — Made to your Specifications"

Circle (109) on Fast Fact Card

USE COLOR

MOTOROLA Radius
DELIVERY NOW!
One of the largest stocks of Motorola Radius in the world.
Every Model in Stock! Free Programming of all new units on Delivery!
Will Positively Be Shipped Tonight!
On your jobsite tomorrow. We can handle any size order and have done so for 21 years.
CALL 1-800-53-RADIO (72346)
(706) 561-7000 FAX: (706) 5684506
To place your order, even if you live in Hawaii, Virgin Islands, Alaska or Puerto Rico, RADIO WHOLESALE - John Cunningham WB4 -JUN

Circle (110) on Fast Fact Card

(800)726-9015 (612)884-8352
- We Have Fast Service.
- We Have a Flat Rate Repair Service.
- We Have a Complete Dealer Support Program.
- We Have a Large Variety of Accessory Items Available

Wholesale Prices to Dealers Only

RADIO COMMUNICATIONS WHOLESALERS

NOW Featuring TEKK
Portables!
Our Prices will Surprise You Even if You Buy Direct from the Factory!!!
☆ **Full Line Distributor of Tekk**
☆ Many other brands also available.
☆ Your One Stop Warehouse for All Your Commmunications Equipment Needs.
24 Hour a Day FAX
(612)884-8356

Circle (111) on Fast Fact Card

Equipment for sale

• MOBILES • BASES • PORTABLES • PAGERS • REMOTES •

• RCA • • MOTOROLA • • GE •

• BUY • • SELL • • TRADE •

PCI — PEKAAR COMMUNICATION INC.

$ Specials of the month $ *Steve's back, formerly of Gregory Electronics Corp.*

GE MLS Mobiles lowband 40-50 range 2 Freq. w/accs	$175
GE Phoenix SX Model N5HH1W40PB highband w/dual priority scan & accs	SPECIAL $200
GE Delta S Model N3CC3N 110TB 110 watt 36 to 42 range w/accs	$150
Motorola MCX100 Model MBD 44EMA1000 UHF 406-420 range less accessories	$75
Motorola Mitrek Model T51JJA 2900 60 watt 42-50 range 4 freq. with accessories, clean, no PL	$150
Motorola MOCOM 70 U41BBA 1900 60 watt 42-50 range 4 freq. w/access., clean, no PL	$65
GE MPE Portable Model P665RBWBMX 450 to 470 range 2 freq. w/CG	$85
GE PE Portables Model PE65RBW 450 to 470 range, 2 freq. w/CG	$75
GE Master 2 Mobiles Model MC74AAS 36-42 range less accessories	$45
GE PLS Portables UHF 450-470 range w/battery and antenna	$175

Catalog Available *If you can't find it, try us!* Call (201) 772-0704

• BOARDS • STRIPS • ACCESSORIES • ELEMENTS • REEDS •

MECHEM ELECTRONICS

Mailing Address:
P.O. Box 7846
Fredericksburg, VA 22404
3605 Loren Whitney Drive
Massaponax Business Park
Fredericksburg, VA 22408

Portable Repeaters PL; VHF & UHF;
DES & DES XL
Portable Test Sets
Nicad Eliminators
Single And Rack Chargers
CISCO Transmitters and Receivers
Speaker Microphones

BASES and REPEATERS
30-36; 36-42; 42-50, 100W, C.D.
150-162, 162-174, 100W, C.D.
450-470, 75W, C.D.
Consolettes; Desktops and Remotes

Many items in stock, call with your requirements.
We have the R1801 DAC for your programming needs. Call us with your requests.

Phone: (703) 891-0569 We accept VISA and Mastercard Fax: (703) 891-0538

Circle (112) on Fast Fact Card

***WholeSale* prices on 2-way radios & more!**

Authorized Distributor
Mobile Communications

PRODUCT *True*Values SERVICE

ORDER TODAY = SHIP TODAY

1-800-548-2484

3403 Governors Drive • Huntsville, AL 35805 • Fax 205-539-1663

Sharp COMMUNICATION Distribution Center

2-Way Sales to Radio Dealers Only

TELEWAVE
Site Management
SAMLEX
Power Supplies
RFI Connectors
WHELEN
Warning Signals

SHEILA TIM JIM

Circle (113) on Fast Fact Card

CLEAN USED GEAR

Cushman CE-4 & CE-6 Service Monitors
GE Phoenix SX VHF, 2/16 CH & Scan
GE MLS LB, VHF, UHF 2/8/16 CH & Scan
GE MASTR II & Exec II LB, VHF, UHF
GE MVP, VHF
GE MASTR II Base/Rptr LB, VHF, UHF
Motorola Mocom, Micor, Mitrek LB, VHF, UHF
Motorola Moxy, Maxar,-50, -80 LB, VHF, UHF
Motorola Mostar 800T
Motorola Base/Rptr/Consolettes LB, VHF, UHF
Standard GX3000 VHF, UHF 64 CH Synth/Scan
Standard 966L LB, 75 Watt, Synth
Mostar VHF, Maxtrac 900 MHz

NEW STANDARD RADIOS AT DISCOUNT!! CALL NOW
Harris Alpha 2000E VHF IMTS
Motorola Pulsar VHF IMTS & Others
Motorola MT500 LB, VHF, UHF HT
Motorola MT/HT/ Gang Chargers
Standard HX300, 320, 734, 834 VHF, UHF HT
Standard HX400 VHF, UHF 25 CH Synth 5W HT
Uniden SPH & SPU 8 CH Synth HT
Wescom 2 GHz Microwave, MUX
Standard GX-1500U
GE Deskon II DC Remotes, Motorola Local Remotes
MORE - MORE - MORE - MORE - MORE - MORE

VersaTel

We Buy Used Equipment - CALL!
Ph: 1-800-456-5548
Fax: 1-307-266-3010

Circle (114) on Fast Fact Card

TRY MRT CLASSIFIEDS THEY WORK

★ NEW LISTINGS ★ NEW LISTINGS ★
★ NEW LISTINGS ★

3	Granger 960 Telemetry Links	$500 ea.
10	Granger 960 Receivers and Transmitters	$100 ea.
1	Hop, GE, 23 Ghz, Video Link	$500 ea.
20	Lenkurt 46A Channel Modem	$100 ea.
60	GTE Lenkurt 3612 Channel Modems	$50 ea.
50	Motorola MC 400 MLN 6153 Channel Modems	$100 ea.
50	MC 400 Term Cards	$50 ea.
3	Micor Base Stations, 100W 42-50	$950 ea.
4	GE Mastr II Base Stations, 100W 42-50, w/ch. guard	$950 ea.
4	GE Mastr II Base Stations, 300W 42-50, w/ch. guard	$1500 ea.
50	GE Ex II, 60W, Multi-ch., Good for 6 meters	$60 ea.
40	GE Delta-S, 110W, ch-guard, w/acc., very good condition	$325 ea.
30	GE Mastr II 100W, ch. guard, w/acc	$150 ea.
6	Motorola Syntor X trunked, Smart-net, Dual Operation control station, NEW	$300 ea.
1	Modax 500	$300 ea.
10	Mitreks, UHF, PL, Multi-ch	$150 ea.
20	Mitreks, 42-50 , PL, Multi-ch	$150 ea.
20	Micors 45W Sys 90 scan, multi-PL, UHF	$100 ea.
20	Mocom 70s, 42-50 PL 100W w/acc	$100 ea.
15	HT220, 4W, PL, w/charger & battery	$50 ea.
10	T1605 w/Mic's	$150 ea.
10	STX 800 Trunked Convertacoms w/RF Amp & Amplified Speaker (LIKE NEW)	$250 ea.
2	Centracom II Desk Top Consoles w/Power Supplies & Channel Control Modules (No Central Elect. Bank)	$1000 ea.

• *SPECIAL* •

1 Box Pagers (Directors, Spirits, PageBoy II, PageBoy III) to contain at least 100 pagers $600. box

Call Charles at CMC Enterprises, 910/769-2885

FOR SALE

E.F. Johnson LTR Mobile Modems
E.F.J. Part No.250-3044-200

Compatible in 8700/8710 and all 800 MHz 86xx series as well as 800 repeaters.

Please contact **LWG, Inc.**
(708) 559-3007 x234 - John Brezinski

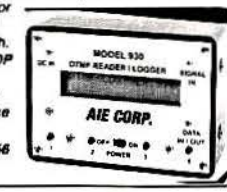
Advanced RF Design, Inc.

Low Noise Preamps

150-170 MHz Gain >24 dB NF <0.4 dB
450-470 Mhz Gain > 18 dB NF <0.45 dB
Priced from $65.00 to $70.00
1 yr. warranty
Call (609) 448-0910 (9 AM-9PM eastern)

The MODEL 930 is a cost effective instrument that can detect, decode, display, and store all of the signaling formats used in the telephony industry. When detected, the signal is identified as DTMF, MF or DP, and tagged as to mode on the display and in the memory. This unit is PC compatible such that data can be transferred to disk or hard drive when on board storage is not large enough. At $118.45 for the DTMF/DP unit or $308.40 for the DTMF/MF/DP version, put one or more in each service location!

AIE CORP. 1-800-397-9256 (FAX 1-803-532-9258)



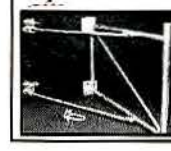
PAGING AMPLIFIERS

UHF-900/800MHz

40 to 300 watts, continuous duty!
Electronically protected, + 2 yr. warranty.
1-800 -LH-AMP-4U 310-865-4923
LH Power Amplifiers, Inc.

S. P. U.

100 Arnold Lane
Paragould, AR 72450
(501)239-9605



48" HEAVY DUTY ANTENNA
SIDE MOUNT
DEALER $289.20
Also available 18" Heavy Duty
Antenna Side Mount Dealer $139.80

Equipment for sale

2-WAY RADIOS

BEST PRICES IN THE U.S.A.!

Motorola Radius and More!

Same Day Shipment
Complete Support Program
Nationwide Distribution

We will BEAT all other verified prices - GUARANTEED!

RADIO MIDWEST INC.

Over 58 Years in Business!

1-800-521-2468

FAX - 913-234-3584

MasterCard VISA

Circle (115) on Fast Fact Card

COURIER

PROCOM VHF & UHF FM TRANSCEIVERS

HANDHELD SYNTHESIZED PROGRAMMABLE 5 WATTS - TEN CHANNELS

PROVIDES INSTANT COMMUNICATIONS WITH KEY PERSONNEL INSIDE/OUTSIDE

NEW

Ideal for use on construction sites, in factories, for security control, and by recreational supervisors.

FEATURES INCLUDE:

- Range 1 to 3 miles subject to environmental conditions.
- Weather resistant with die-cast frame, high impact case with belt clip.
- Rechargeable nickel cadmium battery pack, A.C. battery charger, flexible antenna with BNC connector. F.C.C. license application included
- Jacks for A.C. charger, earphone, external speaker/microphone, and external antenna with BNC connector.
- Volume control/power on-off switch.
- Low/Med/High transmit power output.
- Built-in squelch control.
- Programmable CTCSS tone squelch (optional).
- Battery/transmit and busy LED indicator.
- Channel digital readout.
- Ten channel selector.
- Channel scan with channel lockout.

PROCOM M510 VHF
Extended Range
PROCOM MU510 UHF
High Penetration

FANON COURIER

(800) 345-1354

14811 MYFORD ROAD • TUSTIN, CALIFORNIA 92680
(714) 669-9890 • FAX: (714) 669-1081

Circle (116) on Fast Fact Card

COMPLETE CHANNEL ELEMENTS ON YOUR FREQUENCY FOR $25 - $35!!!

ORDERS ONLY:
1-800-237-6519
INQUIRIES AND IN LA:
504-361-5525

Motrac; Micor, Mocom; Mitrek; Etc. MT's, and GE Elements. Call for prices

Any desired Frequency available for fast delivery.

Lifetime Warranty on Crystals

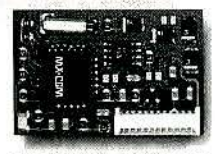
Trade-in credit on your Old Channel Elements

We Buy Used Elements

Try us first. We always have *your* frequency available.

NKX
1814 Hancock St.
Gretna, LA 70053

THINK OF IT AS YOUR WATCHDOG FOR THE AIRWAVES.



***Pvt* SQUELCH™ voice privacy modules are easily installed in most popular radio brands including the Radius GP300™.**

Radio messages are property and, if left unprotected, can legally fall victim to anyone listening in. MX-COM's voice privacy adapters scramble your calls rendering the interception of your information unlawful. ***Pvt* SQUELCH™** modules combine CTCSS tone encoding & decoding *and* voice inversion in one small package. Your transmissions are separated from others sharing the same channel and your messages can only be understood within your designated user group. To place an order or to receive free product bulletins and application notes call us direct at **1 800 638-5577.**

Registered to ISO 9002
Certificate No. A1732

MX•COM, INC.
MiXed Signal ICs and Modules

*Motorola and Radius GP300 are trademarks of Motorola, Inc.

Circle (117) on Fast Fact Card

Equipment for sale

Equipment for sale

Equipment for sale

HENRY RADIO

IN STOCK, BEST PRICES, QUICK SERVICE

ASTRON CORPORATION

MAXRAD State of the Art Antennas

BIRD

Eimac

Radius

HENRY AMPLIFIERS

YAESU

We also stock:

AEA	Larsen
Centurion	Maxon
Comm. Spec.	Maxrad
Connect Systems	Opto
Create	Solar Panels
Cushcraft/Signals	Telex
Henry Cables	Tempo
Hustler	TohTsu
Icom	TPS
JBRO	Uniden
Kenwood	Wavetek

TOLL-FREE (800) 877-7979

HENRY RADIO

2050 South Bundy Drive
Los Angeles, CA 90025

Phone (310) 820–1234
FAX 310–826–7790

Circle (123) on Fast Fact Card

Now in stock: ICOM®

ICOM F30LT VHF/ F40LT UHF portables. Retail $799/$859. Dealer $599/$639. Ninety-six channels, 8 digit alpha, program from its front panel KB OR PC. Upgrade from your H/U16. ICOMS bought, sold and repaired.

SWS Security (410) 879-4035

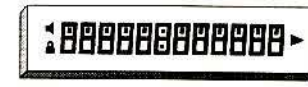
WE BUY AND SELL USED MOTOROLA AND GE FM TWO-WAY RADIOS

SCHAEFER RADIO CO.
130 West Fayette St.,
P.O. Box 395
Denver, IA
50622

PHONE:
(319)
984-6115
FAX:
(319)
984-6220

8 ea.	MTX820S, 800 MHz, H25JKH51C5AN
3 ea.	MICOR Bases, 460 MHz, B84RCB1105AT
6 ea.	MICOR Bases, 460 MHz, C64RCB1105AT
3 ea.	Mastr II Bases, 460 MHz, VC85RAS88B
3 ea.	Mastr II Bases 155 MHz, DC76RAD66A
8 ea.	MICOR Bases, 460 MHz, C54RCB3106
18 ea.	SYNTOR X 9000, 460 MHz, T34KEJ7J04
5 ea.	MICOR, 460 MHz, T54RTA3903
2 ea.	MAXAR 80, 460 MHz, D34TSA6300
2 ea.	MAXAR 50, 460 MHz, D34JJA3300AK
11 ea.	MT500, 460 MHz, H34BBU3124
44 ea.	MITREK, 153 MHz, T83JJA3900
22 ea.	MITREK, 153 MHz, T43JJA3000
49 ea.	SABER Portables, 144 MHz, H430XN7139
2 ea.	MICOR Bases, 47 MHz, C71RTB3406
4 ea.	MARATRAC, 47 MHz, T81XTA7TA7BK
44 ea.	MITREK, 47 MHz, T81JJA4000
8 ea.	MITREK, 48 MHz, T51JJA4900
1 ea.	MICOR BASE, 37 MHz, C71RTB1406
20 ea.	MITREK , 31 MHz, T81JJA4000
2 ea.	Micor Bases, 37 MHz, C71RTB1406
2 ea.	MICOR "PURC" Bases, 37 MHz, B91JZB1101B
1 ea.	MICOR "PURC" Base, 72 MHz, C42JZB6106AC
20 ea.	Tone Remote Consoles, T1604M
60 ea.	Tone and DC Remote Desk Sets, Mixed Models: T1926, T1380, T1902
29 ea.	Local Control Desk Sets, T1370 & T1903
4 ea.	CENTRACOM I Single Bay Tone Remote, MCM w/T & R Modules
5 ea.	CENTRACOM Empty Cabinets
2 ea.	"DVP" Code Programmers, P1001BX
25 Sets	MOTRAC Accessories
50 ea.	MT500 Omni Rapid Chrgrs., NLN4565
13 ea.	MT500 Omni Std. Chrgrs., NLN4561
18 ea.	MT500 Slimline Rapid Chrgrs., NLN4565
6 ea.	MT500 Omni Vehicular Chrgrs, NLN6892
6 ea.	PULSAR II VHF IMTS Phones, Mixed Models
100 ea.	MINITOR I Pagers, 155 MHz, H03EAB1212

L C D's



Superior Japanese Quality!

GUIDE HOLES FOR EASY INSTALLATION
" MICRO PRINTED " FOR EASY ID
LOW FACTORY DIRECT PRICING
NOW IN STOCK : BRAVO • PLUS • LS PLUS
EXPRESS (NEW AND OLD VERSION)

1-800-FIX-BEEP
1-718-783-6000

Now, here's a switch!

CHARGEGUARD®

automatic ON/OFF timer switch
for two-way radios, cellular phones

EASY TO INSTALL.
NO IGNITION SWITCH CONNECTION!

PROGRAMMABLE.
15 MINUTES TO 15 HOURS!!

Prevents Dead Batteries.

MADE IN U.S.A.
PROTECTS YOUR RADIO.
SUGGESTED LIST **ONLY $74.95** MODEL CG1B12N
12 AND 24 VOLT MODELS AVAILABLE

CALL NOW FOR MORE INFORMATION!

ASK ABOUT OUR *NEW* DEALER KIT!!

CHARGEGUARD
400 Highland Avenue
Altoona, PA 16602
800-458-3410

Circle (124) on Fast Fact Card

BUYING ERICSSON-GE EQUIPMENT
CALL OR FAX FOR QUOTE

PORTA MOBILE I Battery, new	$18
1/4KW GE sta. blower motor new	$35
Mastr II base sta wire harness	$25
GE Mobile repeater, VHF, w/cable	$65
MPI UHF 4W tech. special	4/100
MPI 8-Unit multicharger, checked	$40
Rangr 450-470 less acc. 100W	$325
Delta-S 450-470 less acc. 100W	$295
Delta-S 450-470 40W S-990 acc	$299
Delta-S 42-50 less acc. 110W	$135
Delta-S 450-470 40W no acc.	$150
MLS-I Control panel 8 ch scan	$65
MLS -I Cont. panel 16 ch no scan	$60
Speaker mic. PCS/MPA/MPD	$35
Phoenix-SX VHF 16 ch. scan	$225
Phoenix-SX VHF 2 or 16 ch.	$200
PLS/MPD/MPA Multi-chgr. new	$100
PLS/MPD/MPA/TPX Rapid desk new	$72
MASTR II 150-174 110W from	$115
MASTR II 42-50 110w w/acc	$165
MASTR II Accessories, complete	$50
MASTR II Multi-channel cables	$20
MASTR II C-500 w/scan or PA	$25
S-825 scan or systems w/warr	$225
S-990 128 ch. head w/warranty	$125
S-950 128 ch. head w/warranty	$75
MPS/MPR/MPX/MPI/MPD Chargers	call

NEW LONDON TECHNOLOGY
231 Old Timberlake Road
Forest, Virginia 24551
TEL 804-525-0068 FAX 804-525-0078

CONNECTORS FOR SALE

BRAND NEW • • • ANDREW L74PN
Hard-line connectors for 1 5/8" Premium silver platted & sealed in manufacturer's original packaging. Quantity in stock is limited--- $125 each plus shipping and handling. To place an order please call:
(912) 244-9402

WANTED: USED SERVICE MONITORS

BUY • SELL • MOTOROLA • MARCONI • HP
SALE: IFR 1500-$6500, 1200S/TG-$6900, 1100S-$4200, IFR 1000S-$3600, 500A-$3900, CE50A-$2800, MOTOROLA R2001D-$6500, R2001A-$3900

Radio One
PH: 716-661-9964 H: 716-763-9104, FAX: 716-763-0371

SHORES COMMUNICATION CO., INC
602-425-5870

MOTOROLA Radius Authorized Dealer

- SALES
- SERVICE

Classified

Equipment for sale

Model SVR-200 Synthesized UHF Vehicular Repeater

- Synthesized-All parameters PC programmable
- Motorola PAC/RT® fully compatible
- "First man out" with priority sampling
- Multiple vehicle operation: up to 256 units
- LTR®, EDACS® & Motorola trunking compatible
- Optional remote channel steering via DTMF
- Easily interfaces to any make or model mobile
- App notes available for most public safety radios

- ***Public Safety*** - Wide area coverage without satellite receivers
- ***EMS*** - Paramedics maintain communications even inside buildings
- ***Utilities*** - Crossband repeat works with existing lo-band systems
- ***800/900 Trunking*** - Mobile coverage with a low power handheld
- ***Fleets*** - Eliminate pagers, cell phones and missed calls.

PYRAMID COMMUNICATIONS
1198 Pacific Coast Hwy
Suite D-286
Seal Beach CA 90740
(310) 430-5892

TECH-NET BBS

BUY • SELL • TRADE new and used radio equip ment. Over 100 users worldwide. FREE to all two-way techs and dealers. In service and still no charge for over 3 years.
THE TECH-NET BBS 615-235-3772

K E N W O O D®

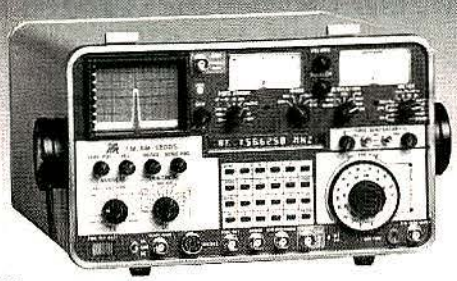
Flat Rates	Beltronics,Inc.	We sell
Repairs and/or Estimates	Dept MR 19 Proctor Hill Rd.	Parts - Accy
Mobiles $39	Hollis, N.H. 03049	
Portables $59	1-800-3-BELTRON	FREE
plus	We replace GUESS by TEST	programming
Parts/Shipping	Let our 27 years of	on new radios
	experience help you.	Daily UPS

MOTOROLA
PORTABLE & PAGER REPAIR

• PAGERS	$ 10 + PARTS
• PORTABLES	$ 29 + PARTS
• SYNTH. PORTABLES	$ 49 + PARTS

• QUICK TURN AROUND • FREE RETURN SHIPPING
TEL: 1-800-567-5636 FAX: 804-469-4900
ARCOM, INC. 13509 Boydton Plank Road Dinwiddie, VA 23841

SERVICE MONITOR REPAIR/CALIBRATION



Specializing in Service Monitors since 1973

We buy and sell used IFR monitors!

Phone (970) 962-9998
FAX (970) 962-3991

COMMUNICATION INSTRUMENTS
1714 SW 23rd Street, Loveland, CO 80537

4/95

Repair services

Loudoun Communications Inc.
Communications Systems
REPAIR DEPOT

QUALITY SERVICE ON MICROPROCESSOR BASED MOBILES, PORTABLES AND CONTROL HEADS. SURFACE MOUNT REPAIR. MOST REPAIRS $60 PLUS PARTS. FREE ESTIMATES.

Warranty Service Available On:
Ericsson/G.E. • Kenwood • Maxon

585 Factory Shoals Rd.
Austell, Ga. 30001 404-948-9566

NS ELECTRONICS SERVICE INC.

COMMUNICATIONS MONITORS SALES & SERVICE
N.I.S.T. TRACEABLE CALIBRATION
CUSHMAN IFR
DISTRIBUTOR FOR OPTO ELECTRONICS, INC.
SALES NEW-USED

3610 Dekalb Technology Parkway
Suite 110/111
Atlanta, Georgia 30340
(404) 451-3264
Fax: (404) 458-8785

CALL

AUTHORIZED CUSHMAN SERVICE

USE COLOR

Repair services

$25.00 FLAT RATE
Plus Parts & Shipping
On the following models:

XLH-250	RH-250
RH-256	WH-2516
WH-2510	RFH-252
UC-102	UC-202
TRH-202	

REGENCY/WILSON
*OTHER MODELS—$30/HR Plus Parts & Shipping

MULTICOM
527 S. Broadway
Moore, OK 73160
405-799-7356 800-880-7356

• FAST TURNAROUND
• FACTORY TRAINED
• VISA - MASTERCARD - COD

MOTOROLA
Authorized Service

- Authorized warranty Service
- Quick Turn Around
- Flat Rate Repair Available
- Free Estimates
- Quantity Discounts

COMMUNICATIONS SOLUTIONS
(719)547-3683

CUSHMAN

- Reliable Cushman repair
- Cushman products can be maintained
- Factory trained personnel support available-always has been
- KNS Electronics Inc. continues support to the land mobile industry that was provided by Cushman for 35 years
- Trade-in offered when new equipment purchased
- Call for an appointment to have your Cushman repaired or calibrated

NEW EQUIPMENT MANUFACTURED BY:
KNS ELECTRONICS, INC.
1609 REGATTA LANE, UNIT A
SAN JOSE, CA 95112
PHONE (408) 432-8100
FAX (408) 432-8359

Circle (125) on Fast Fact Card

Computer software

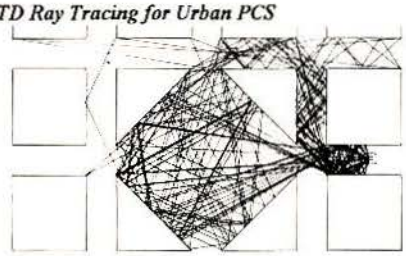
Computer software

PCS System Design

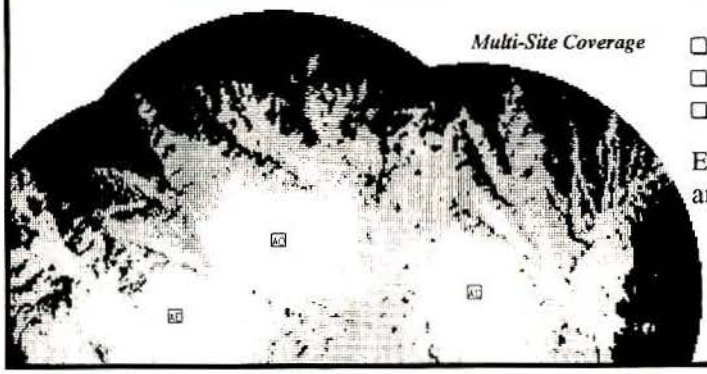
With more than 20 years experience in propagation modeling, EDX is the world leader in innovative PC coverage and link analysis software. We offer proven, affordable PCS system planning tools including:

- ❑ Multi-transmitter coverage prediction with 2-D and 3-D plots of signal levels, C/I ratios, and most likely server studies (**MSITE**™)
- ❑ Microwave link studies with interference prediction from other links and PCS transmitters (**TPATH**™)
- ❑ Selectable propagation models (TIREM, Okumura, FCC, CCIR, etc.) with time and location statistics
- ❑ The first PC-based UTD ray-tracing software for urban PCS and indoor wireless LAN design (**MCS**™)
- ❑ The first complete US 3 second terrain database on a single CD-ROM
- ❑ Terrain databases for the U.S., Great Britain, Canada, Mexico and other countries on CD-ROM or diskette
- ❑ Custom terrain, groundcover, and building databases
- ❑ EDX programs are full 32 bit applications
- ❑ Demonstration disks available

UTD Ray Tracing for Urban PCS



Multi-Site Coverage



EDX is your single source for propagation prediction tools and databases. Send for our full color catalog today.

EDX Engineering, Inc.
P.O. Box 1547, Eugene, Oregon 97440 USA
Tel: (503) 345-0019 Fax: (503) 345-8145

Circle (130) on Fast Fact Card

Software For
FCC Forms 402 489 494
FCC Licensing and Price Quotes
Form 600!
Slattery Software
(941) 697-8008

SOFTWARE BREAKTHROUGH

Save Time and Money
Managing Wireless Radio Communication Sites!

If You Manage One or Hundreds of Wireless Communications Sites, You Need ComSiteManager

- Site Facilities Information
- Track FCC License and FAA Data
- Track Leases, Rates and Billing Information
- Site Equipment Inventory and Maintenance Records
- Compatible With ComSitePlus Interference Analysis Software

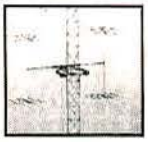
COMSITE™ MANAGER
BY DOUGLAS INTEGRATED SOFTWARE

Call:
800-845-0408
904-656-8673

1350-E4 Mahan Drive, Ste 160,
Tallahassee, Florida 32308

Circle (131) on Fast Fact Card

Rotators



TIC RINGROTOR
For Information
CALL
TIC General, Inc.
1-800-TIC-RING or fax: (218)681-8509

Mobile Radio Technology

For More Information contact:
9800 Metcalf Ave., Overland Park, KS 66212-2215
Toll-Free 800-771-3351
(913) 967-1923
Fax: (913) 967-1735

Lightning prevention

LIGHTNING PREVENTION SYSTEMS

STATIC DISSIPATION AND GROUNDING SYSTEMS FOR COMMUNICATIONS TOWER SITES

204B Cross Keys Road, Berlin, NJ 08009
FAX 609-767-7547 • **(609) 767-7209**
Don't Wait Until It's Too Late!

Make the Discovery

use MRT Classifieds

Rentals

Two-Way Radio

Rentals and Sales
*Daily, *Weekly, *Monthly
Very Low Rates
Featuring **Motorola** portables!

BigHorn Communications

1-800-539-2220

Equipment Wanted

Equipment Wanted
Motorola, Johnson, GE
EFJ, Uniden, Standard
Buy-Comm-Co.
1-800-347-4121
FAX (602) 585-6900

Business Opportunity

TELECOM NETWORK INCORPORATED

$$ CA$H IN $$
Earn Top Dollar
Loading Community Repeaters.
Alabama ◇ Georgia ◇ Florida
Tennessee ◇ Mississippi

FOR INFORMATION CALL:
800-494-3090

MOTOROLA Radius Rentals

- GP300, P200
- Mobiles, Repeaters
- Intrinsically Safe
- Dealers Welcome

1-800-822-MOSS **MOSS COMMUNICATIONS**

Frequency Data

REGIONAL FREQUENCY DATABASE SYSTEMS ON CDROM

New Data!

Now For Windows!

Data Access Program Included
* Fast !!! Easy To Use !!! Multi-Screens !!!
* More Fields : Over 60 Fields
* Many New Program Enhancements
* Import / Export / UFDBF/ Build Your Own Databases
* Faster Searches (Over 2 Times Faster)

Call for more info and pricing on our complete product line.

PerCon Corporation
4906 Maple Springs / Ellery Road
Bemus Point, NY 14712
(716) 386-6015 (716) 386-6013 FAX

MEMORIES FAD

After 1 month.

Don't let it happen. Make sure the memory of your ad stays with your target audience.

Mobile Radio Technology

CALL:
(913)
967-1923

MOTOROLA RADIO RENTALS

- MT1000, HT600, P200
- Intrinsically Safe
- All Types Headphones
- Mobiles & Portapacks
- Repeaters & Crossband Sets
- Dealer Inquiries Invited

1-800-283-COMM
EVENT RENTAL COMM., INC.

Tower space

40+ choice antenna sites in California.

- Stand-by Power / Air cond.
- Continuous Monitoring
- High-Security Access System
- Land available for developing your own site at Oat Mountain, Chatsworth

Meridian Communications
Great sites, great service, since 1956

Call Rich or Jack Reichler at
(800)400-SITE

Circle (132) on Fast Fact Card

Classified

Tower space

Tower services

Ad index/hot line

Company	Page Number	Fast Fact Number	Advertiser Hotline
Advanced Receiver Research	70	62	203-582-9409
Advanced Signal	55	47	217-224-2387
Allen Telecom Group	IFC	1	216-349-8400
Andrew Corporation	38-39	33	708-349-3300
The Antenna Farm	97	121	800-255-6222
Astron Corporation	23	19	714-458-7277
Avcom of Virginia	78	74	804-794-2500
Avtec Inc.	40	34	803-892-2181
Bird Electronic Corp.	75	69	216-248-1200
Bomar	60	51	800-526-3935
Bramco, Inc.	97	120	513-773-6255
Cablewave Systems	47	40	203-239-3311
CELWAVE	9	8	800-321-4700
C.E.T., Inc.	80	77	904-426-0014
Chargeguard Corp.	98	124	800-458-3410
Cimarron Technologies	25	22	800-487-7184
David Clark Co., Inc.	12	9	508-751-5800
Communication Instruments	99		303-962-9998
Communications Associates	92	108	800-435-9313
Communications Data Services	100	126	800-441-0034
Communications Specialists	BC	3	800-854-0547
COMTELCO Industries, Inc.	66	58	800-634-4622
Connect Systems, Inc.	13	10	800-545-1349
Control Signal Corp.	24	20	303-989-8000
CPI Communications Inc.	72	65	214-437-5320
Crystronics, Inc.	91	106	305-566-6949
Cushcraft/Signals Corp.	19	16	800-258-3860
Datacom, Inc.	52	44	217-222-0160
Diablo Communications, Inc.	103	133	510-236-3700
Doppler Systems, Inc.	82	81	602-488-9755
Douglas Integrated Software	101	131	904-656-8673
DuraComm Corp.	85	87	816-746-8300
EAGLE	81	78	602-204-2597
Eagle Telecom International	33	29	713-280-0488
EDX Engineering, Inc.	101	130	503-345-0019
El Paso Communication Systems	64	56	915-533-5119
E Trunk Systems, Inc.	97	122	914-245-1128
Fanon Courier	95	101	800-345-1354
Fourth Dimension	91	105	516-467-1220
Glenayre	53	45	404-623-4900
Grayson Electronics	17	14	800-800-7465
Haewa Corporation	82	80	800-783-4239
Hark Electronic Systems, Inc.	65	57	803-875-4480
Henry Radio	74,98	68,123	800-877-7979
Hustler, Inc.	41	35	800-949-9490
Hutton Communications	14,16	11,13	800-442-3811
Hy-Q International	93	109	606-283-5000
IFR Systems, Inc.	37	32	316-522-4981
JBRO Batteries, Inc.	27	23	800-323-3779
KNS Electronics, Inc	99	125	408-432-8100
Kyodo West, Inc.	75	70	800-535-2082
Larsen Electronics	36	31	800-426-1656
Leavitt Communications, Inc.	69	61	708-982-0220
Loral Microwave-Narda West	45	38	916-638-5500
Marconi Instruments	49	42	800-233-2955
Marketronics Corp.	22	18	800-845-1230
Maxrad, Inc.	43	36	800-323-9122
McManus Communications	90	103	501-763-6250
Mechem Electronics	94	112	703-891-0569
Meridian Communications	57	48	818-222-5655
Microflect	IBC	2	503-363-9267
Microwave Filter Company Inc.	18	15	315-437-3953
Midian Electronics, Inc.	15	12	602-884-7981
Mobile Radio Technology Reprints	90	135	913-967-1969
Modular Communication Systems	62	53	818-764-1333
Motorola Americas Parts Division	59	50	
Motorola Flex	2,3	5	407-739-FLEX
Motorola Test Equipment	7,68	7,60	800-505-TEST
MX-COM, Inc.	95	117	800-638-5577
NATCOM Inc.	61	52	800-844-8287
Norcomm Corp.	74	67	916-477-8400
Northstar Communications	63	54	800-606-7437
Norton Engineering	100	127	703-938-5745
Optoelectronics, Inc.	46	39	800-327-5912
PageTek, Inc.	84	84	919-876-8294
Percon Corporation	102	132	716-386-6015
Personal Comms Industry Assn.	71	63	800-416-5521
Photocomm, Inc.	84	85	800-223-9580
Pirod, Inc.	85	86	219-936-4221
Polaris Industries	92	108	800-752-3571
Polyphaser Corporation	78	73	800-325-7170
Pyramid Communications	99		310-430-5892
Radio Midwest	95	115	800-521-2468
Radio Wholesale	93	110	800-53-RADIO
Ramsey Electronics	90	102	800-446-2295
RCW Distributing	93	111	800-726-9015
RELM Communications	82	82	800-874-4665
RMS Communications	89	101	904-873-0222
Rocky Mountain Comms Inc.	100		303-526-5454
Santa Fe Distributing	72	64	913-492-8288
Selectone Corporation	35	30	800-227-0376
Sentry Manufacturing Co.	90	104	800-252-6780
Serviceware Corporation	64	55	613-521-7391
Sharp Communication	94	113	800-548-2484
Shure Brothers, Inc.	32	28	800-25-SHURE
Sinclair Technologies, Inc.	44,83	37,83	905-727-0165
SMC Electro-Mount	76	71	800-527-1079
SoftWright	100	128	303-344-5486
Solar Electric Specialties	30	26	800-344-2003
Spectrum Communications Corp.	81	79	610-631-1710
TESSCO	29,31		800-472-7373
TGA Systems, Inc.	51	43	404-441-2100
Times Microwave Systems	54	46	203-949-8400
Towerwatch	103	134	800-475-1780
Transcrypt International, Ltd.	5	6	800-276-8799
Tripp Lite	28	24	312-329-1407
TX RX Systems, Inc.	67	59	716-549-4700
Valmont Industries, Inc.	77,79	72,75	402-359-2201
Vega, A Mark IV Company	1	4	818-442-0782
Versatel Communications	94	114	800-456-5548
Vocom Products Company LLC	86	88	800-USA-MADE
Wacom Products, Inc.	24	21	817-848-4435
WAVETEK	21	17	800-392-8100
West Coast Radio	96	119	310-268-2464
Wetec Electronics	96	119	901-286-6275
Zetron, Inc.	48,58,73	41,49,66	206-820-6363
Z Technology	80	76	503-591-5051

Circle (2) on Fast Fact Card

Microflect

Read All About It!

In Microflect's Component Catalog

Your one-stop source for
- Waveguide Support Systems
- Antenna Support Structures
- Tower Accessories
- Hardware

At Microflect, we've been busy making headlines. What's all the excitement about? Our comprehensive Component Catalog – quite simply, the industry's most extensive catalog. It's filled with well over 1,000 products, including application illustrations, new product descriptions, in-depth specifications and easy-to-reference pricing. Supporting this vast array of products is our highly knowledgeable staff, with the application and product expertise to help make your planning, engineering, purchasing and installing as easy as it should be.

You'll also appreciate Microflect's proven commitment to quality and close attention to even the smallest details, from product concept to completion. The result is a component product line known industry-wide for quality craftsmanship, precision and functionality.

We invite you to call today for your free catalog. If you'd like, we'll also send along our PC-based Component Catalog Pricing Diskette for easy price configurations. So read all about it... All it takes is one toll-free call.

Serving the Communications In since 1956.

(800) 547-2151 Ask for extension 901
FAX (503)363-4613
3575 25th St. SE · Salem, OR 97302-1190

Visit us at PCS, Booth # 337.

Microflect

Communication Towers | Custom Structures | Field Services | Passive Repeaters | Components

TP-3200 $279.95

Full Featured Shared Repeater Tone Panel with ALL 157 CTCSS/DCS codes. In Desktop or Rack Mount version.

CSI-100 $749.95

Video Modem. Sends and receives broadcast quality, single frame, color video over ANY narrow-band communications channel.

ID-8 $89.95

Automatic Morse Station Identifier. Meets all FCC ID Requirements. Fully field programmable with included keypad. 1.85" x 1.12" x .35"

TE-64 $79.95

Self-contained Encoder, Rotary Dial Selection. Great for the Benchtop. 5.25" x 3.3" x 1.7"

CC-1/CR-1 $49.95 each

Surface Mount Component Kits for repairing SMT circuits. CC-1 for capacitors/CR-1 for resistors.

PE-1000 $224.95

Desktop Paging Encoder. Two-tone sequential, other formats available. 7.5" x 7.8" x 2.7"

PE-2P $54.95

Two-tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability. 1.25" x 2.0" x .4"

SD-1000 $59.95

Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"

DTD-1 $59.95

Single Function DTMF Decoder. Provides switch outputs via DTMF. 1.25" x 2.0" x .4"

PE-4/PE-15 $99.95

Multiple Call POCSAG (RPC-1) Paging Encoders. Where direct control of local area paging is desired. 1.78" x 1.03" x .35"

DCS-23 $59.95

Digital Coded Squelch Encoder-Decoder. Programmable to all codes. 1.36" x 1.18" x .25"

TS-32P $57.95

Programmable CTCSS Encoder-Decoder. Tone squelch for any FM transceiver. 1.25" x 2.0" x .4"

TS-64 $64.95

Sub-miniature Programmable CTCSS Encoder-Decoder. 1.7" x .78" x .25"

SS-32SMP $27.95

Sub-miniature CTCSS Encoder. Jumper programmable. .53" x 1.0" x .16"

SS-32PA $28.95

Programmable CTCSS Encoder. Custom tones or audible tones also available. .9" x 1.3" x .4"

The Sky's The Limit!

For over 25 years... bringing you tone signalling products that are as reliable as the day is long. Combine this with same-day shipping, toll-free technical support, and our no hassle one year warranty, and you'll realize the sky's the limit in our efforts toward customer satisfaction.

Shown are a few of our most popular tone signalling products. Call for details on these and all your tone signalling needs. A free catalog will be mailed upon request.

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

VISA MasterCard

Outside USA or Canada: Jescom International, 1 Waters Park Dr. #117, San Mateo, CA 94403 USA · Phone (415) 574-1421 · FAX (415) 574-5297 · Also in Italy and Spain

Circle (3) on Fast Fact Card